TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation and Habitat Alteration

In The

South Fork Holston River Watershed (HUC 06010102)

Carter, Greene, Hawkins, Johnson, Sullivan, and Washington Counties, Tennessee

FINAL

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
CFR	Code of Federal Regulations
DEM	Digital Elevation Model
EFO	Environmental Field Office
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NSL	National Sediment Laboratory
RM	River Mile
RMCF	Ready Mixed Concrete Facility
STP	Sewage Treatment Plant
STATSGO	State Soil and Geographic Database
SWPPP	Storm Water Pollution Prevention Plan
SSURGO	Soil Survey Geographic Database
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

SOUTH FORK HOLSTON RIVER WATERSHED (HUC 06010102)

Total Maximum Daily Load for Siltation/Habitat Alteration in Waterbodies Identified on the State of Tennessee's *2004 303(d) List*

Impaired Waterbody Information:

State: Tennessee
Counties: Carter, Greene, Hawkins, Johnson, Sullivan, and Washington
Watershed: South Fork Holston River Watershed (HUC 06010102)
Watershed Area: 557 mi^2
Constituent of Concern: Siltation/Habitat Alteration
Impaired Waterbodies: *2004 303(d) List*

Waterbody ID	Impaired Waterbody	Miles/Ac
TN06010102001_0100	Madd Branch	2.7
TN06010102006T_0100	Gammon Creek	3.8
TN06010102006T_0200	Wagner Creek	5.5
TN06010102006T_0300	Candy Creek	3.2
TN06010102012_0100	Unnamed Trib To South Fork Holston River	2.0
TN06010102012_0200	Paddle Creek	4.44
TN06010102012_0300	Unnamed Trib To South Fork Holston River	3.89
TN06010102012_0700	Dry Creek	1.0
TN06010102012_0810	Big Arm Branch	5.77
TN06010102042_0200	Back Creek	14.1
TN06010102042_0500	Cedar Creek	11.8
TN06010102042_2000	Beaver Creek	10.5
TN06010102046_0100	Transbarger Branch	1.4
TN06010102046_1000	Reedy Creek	2.0
TN06010102237_1000	Muddy Creek	12.3
TN060101020540_0800	Paint Spring Branch	1.0

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in watershed also classified for domestic and/or industrial water supply.

Applicable Water Quality Standard: Most stringent narrative criteria applicable to fish & aquatic life use classification.

Biological Integrity: The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.

Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion and (b) is of the appropriate stream order specified for the bioregion and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.

Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.

Habitat: The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

TMDL Development

General Analysis Methodology:

- Analysis performed using the Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation (USLE)) applied to impaired HUC-12 subwatershed areas to calculate existing sediment loads.

- Target sediment loads (lbs/acre/year) are based on the average annual sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).

- TMDLs are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.

- 5% of subwatershed target loads are reserved to account for Waste Load Allocations (WLAs) for Ready Mixed Concrete Facilities (RMCFs) and regulated mining sites. Most loading from these sources is small compared to total loading. Since the Total Suspended Solids (TSS) component of Sewage Treatment Plant (STP) discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced from erosional processes, TSS discharges from

STPs were <u>not</u> considered in the TMDL analysis (ref.: Sections 3.0 and 6.0).

- WLAs for Municipal Separate Storm Sewer Systems (MS4s), WLAs for National Pollution Discharge Elimination System (NPDES) regulated construction storm water discharges, and Load Allocations (LAs) for nonpoint sources are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate reduced target load (target load minus 5% reserved WLAs for RMCFs and mining sites).

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

Margin of Safety (MOS): Implicit (conservative modeling assumptions).

TMDL/Allocations

TMDLs, WLAs for MS4s and Construction Storm Water Sites, and LAs for Nonpoint Sources:

HUC-12 Subwatershed (06010102___)	Waterbody ID	Waterbody	Level IV Ecoregion	TMDL (Required Overall Load Reduction)	Required Load Reduction	
					WLA (Construction SW and MS4s)	LA (Nonpoint Sources)
				[%]	[%]	[%]
0302	060101020540_0800	Paint Spring Branch	66e	96.0	96.2	96.2
0401	06010102012_0300	Unnamed Trib To South Fork Holston River	67f	30.8	34.2	34.2
0402	06010102012_0100	Unnamed Trib To South Fork Holston River	67f	15.1	19.3	19.3
	06010102012_0200	Paddle Creek				
	06010102012_0700	Dry Creek				
	06010102012_0810	Big Arm Branch				
0403	06010102006T_0100	Gammon Creek	67f	8.6	13.2	13.2
	06010102006T_0200	Wagner Creek				
	06010102006T_0300	Candy Creek				
	06010102237_1000	Muddy Creek				
0502	06010102042_0200	Back Creek	67i	63.7	65.5	65.5
	06010102042_0500	Cedar Creek				
	06010102042_2000	Beaver Creek				
0602	06010102001_0100	Madd Branch	67f	48.2	50.7	50.7
0604	06010102046_0100	Transbarger Branch	67f	49.5	52.0	52.0
	06010102046_1000	Reedy Creek				

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration.

WLAs for RMCFs and Mining Sites:

WLAs for NPDES regulated RMCFs and mining sites located in impaired subwatersheds are equal to existing permit limits for TSS.

RMCFs Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010102___)	NPDES Permit No.	Facility Name	TSS Daily Max Limit [mg/l]	TSS Cut-off Conc. (SW Discharge) [mg/l]
0602	TNG110297	Transit-Mix Concrete Company	50	200
0604	TNG110123	Tri-Cities Concrete Co., Inc.		
	TNG110140	Byerley Const. Co. Inc.		
	TNG110249	Ross Prestressed Concrete Co., Inc.		

Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010102___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0502	TN0064157	Vulcan Construction Materials, LP	40
0602	TN0054445	General Shale Products, LLC	

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION SOUTH FORK HOLSTON RIVER WATERSHED (HUC 06010102)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Impaired waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not attaining water quality standards. State water quality standards consist of designated use(s) for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA, 1991).

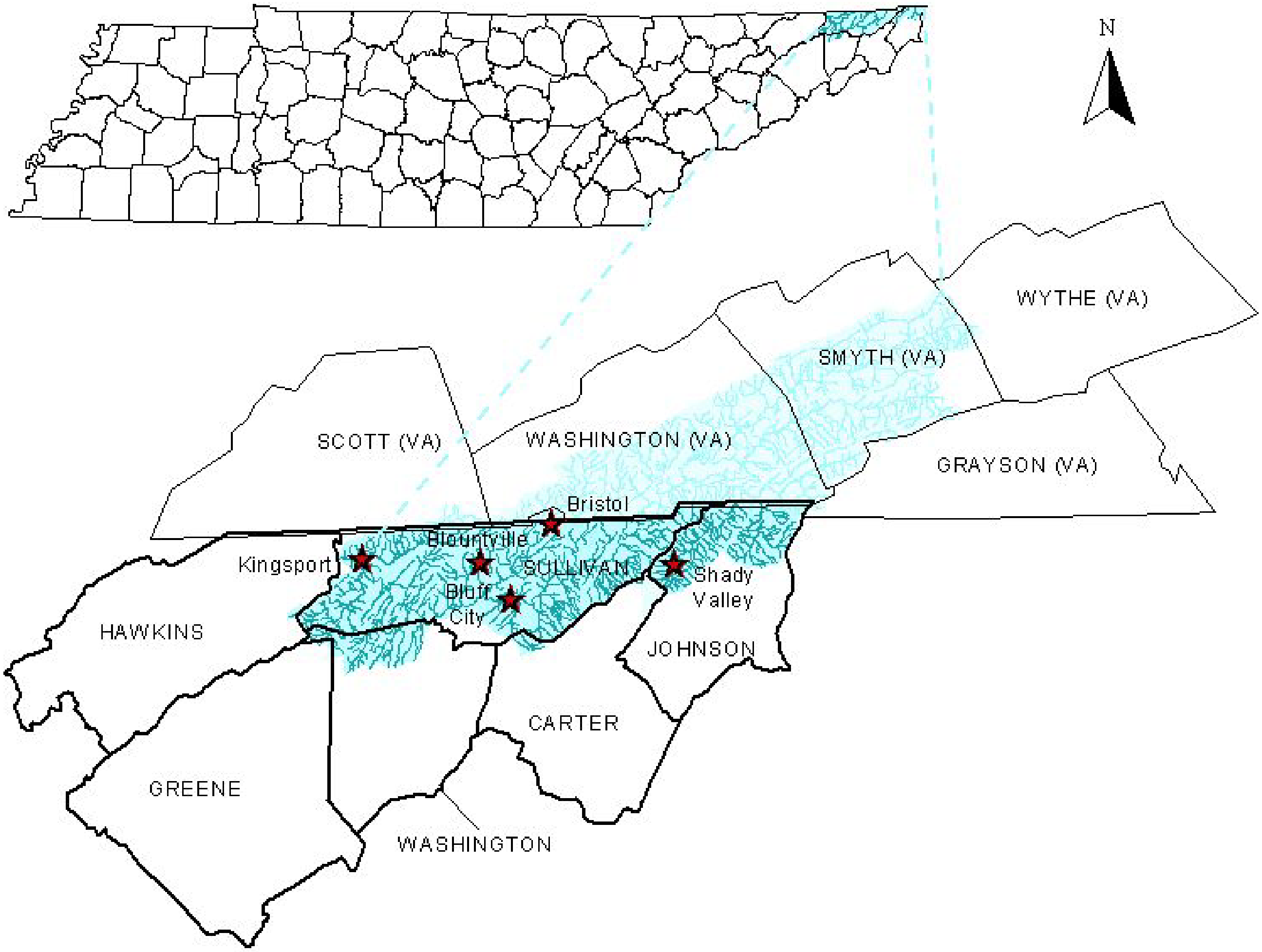
2.0 WATERSHED DESCRIPTION

The South Fork Holston River Watershed, Hydrologic Unit Code (HUC) 06010102, is located in Virginia and East Tennessee (ref.: Figure 1). The information (including figures and tables) presented hereafter in this document is for the Tennessee portion of the watershed only. The watershed includes parts of Carter, Greene, Hawkins, Johnson, Sullivan, and Washington counties in Tennessee. The South Fork Holston River Watershed lies within two Level III ecoregions (Blue Ridge Mountains and Ridge and Valley) and contains six Level IV subecoregions as shown in Figure 2 (USEPA, 1997):

- The Southern Igneous Ridges and Mountains (66d) occur in Tennessee's northeastern Blue Ridge near the North Carolina border, primarily on Precambrian-age igneous and high-grade metamorphic rocks. The typical crystalline rock types include granite, gneiss, schist, and metavolcanics, covered by well-drained, acidic brown loamy soils. Elevations of this rough, dissected region range from 2,000-6,200 feet, with Roan Mountain reaching 6286 feet. Although there are a few small areas of pasture and apple orchards, the region is mostly forested; Appalachian oak and northern hardwoods forests predominate.

- The Southern Sedimentary Ridges (66e) in Tennessee include some of the westernmost foothill areas of the Blue Ridge Mountains ecoregion, such as the Bean, Starr, Chilhowee, English, Stone, Bald and Iron Mountain areas. Slopes are steep, and elevations are generally 1000-4500 feet. The rocks are primarily Cambrian-age sedimentary (shale, sandstone, siltstone, quartzite, conglomerate), although some lower stream reaches occur on limestone. Soils are predominantly friable loams and fine sandy loams with variable amounts of sandstone rock fragments, and support mostly oak and oak-pine forests.

Figure 1 Location of the South Fork Holston River Watershed



- Limestone Valleys and Coves (66f) are small but distinct lowland areas of the Blue Ridge, with elevations mostly between 1,500 and 2,500 feet. About 450 million years ago, older Blue Ridge rocks to the east were forced up and over younger rocks to the west. In places, the Precambrian rocks have eroded through to Cambrian or Ordovician-age limestones, as seen especially in isolated, deep cove areas that are surrounded by steep mountains. The main areas of limestone include the Mountain City lowland area and Shady Valley in the north; and Wear Cove, Tuckaleechee Cove, and Cades Cove of the Great Smoky Mountains in the south. Hay and pasture, with some tobacco patches on small farms, are typical land uses.

- The Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f) form a heterogeneous region composed predominantly of limestone and cherty dolomite. Landforms are mostly low rolling ridges and valleys, and the soils vary in their productivity. Landcover includes intensive agriculture, urban and industrial, or areas of thick forest. White oak forests, bottomland oak forests, and sycamore-ash-elm riparian forests are the common forest types, and grassland barrens intermixed with cedar-pine glades also occur here.

- The Southern Shale Valleys (67g) consist of lowlands, rolling valleys, and slopes and hilly areas that are dominated by shale materials. The northern areas are associated with Ordovician-age calcareous shale, and the well-drained soils are often slightly acid to neutral. In the south, the shale valleys are associated with Cambrian-age shales that contain some narrow bands of limestone, but the soils tend to be strongly acid. Small farms and rural residences subdivide the land. The steeper slopes are used for pasture of have reverted to brush and forested land, while small fields of hay, corn, tobacco, and garden crops are grown on the foot slopes and bottom land.

- The Southern Dissected Ridges and Knobs (67i) contain more crenulated, broken, or hummocky ridges, compared to the smoother, more sharply pointed sandstone ridges of Ecoregion 67h. Although shale is common, there is a mixture and interbedding of geologic materials. The ridges on the east side of Tennessee's Ridge and Valley tend to be associated with the Ordovician-age Sevier shale, Athens shale, and Holston and Lenoir limestones. These can include calcareous shale, limestone, siltstone, sandstone, and conglomerate. In the central and western part of Ecoregion 67, the shale ridges are associated with the Cambrian-age Rome Formation: shale and siltstone with beds of sandstone. Chestnut oak forests and pine forests are typical for the higher elevations of the ridges, with areas of white oak, mixed mesophytic forest, and tulip poplar on the lower slopes, knobs, and draws.

The Tennessee portion of the South Fork Holston River Watershed (HUC 06010102) has approximately 864 miles of streams and 12,884 reservoir/lake acres (based on the USEPA/TDEC Assessment Database (ADB)) and drains approximately 557 square miles to the Tennessee River. Watershed land use distribution is based on the 2001 Multi-Resolution Land Characteristic (MRLC) satellite imagery databases derived from Landsat Thematic Mapper digital images from 2001. Land use for the South Fork Holston River Watershed is summarized in Table 1 and shown in Figure 3.

Figure 2 Level IV Ecoregions in the South Fork Holston River Watershed

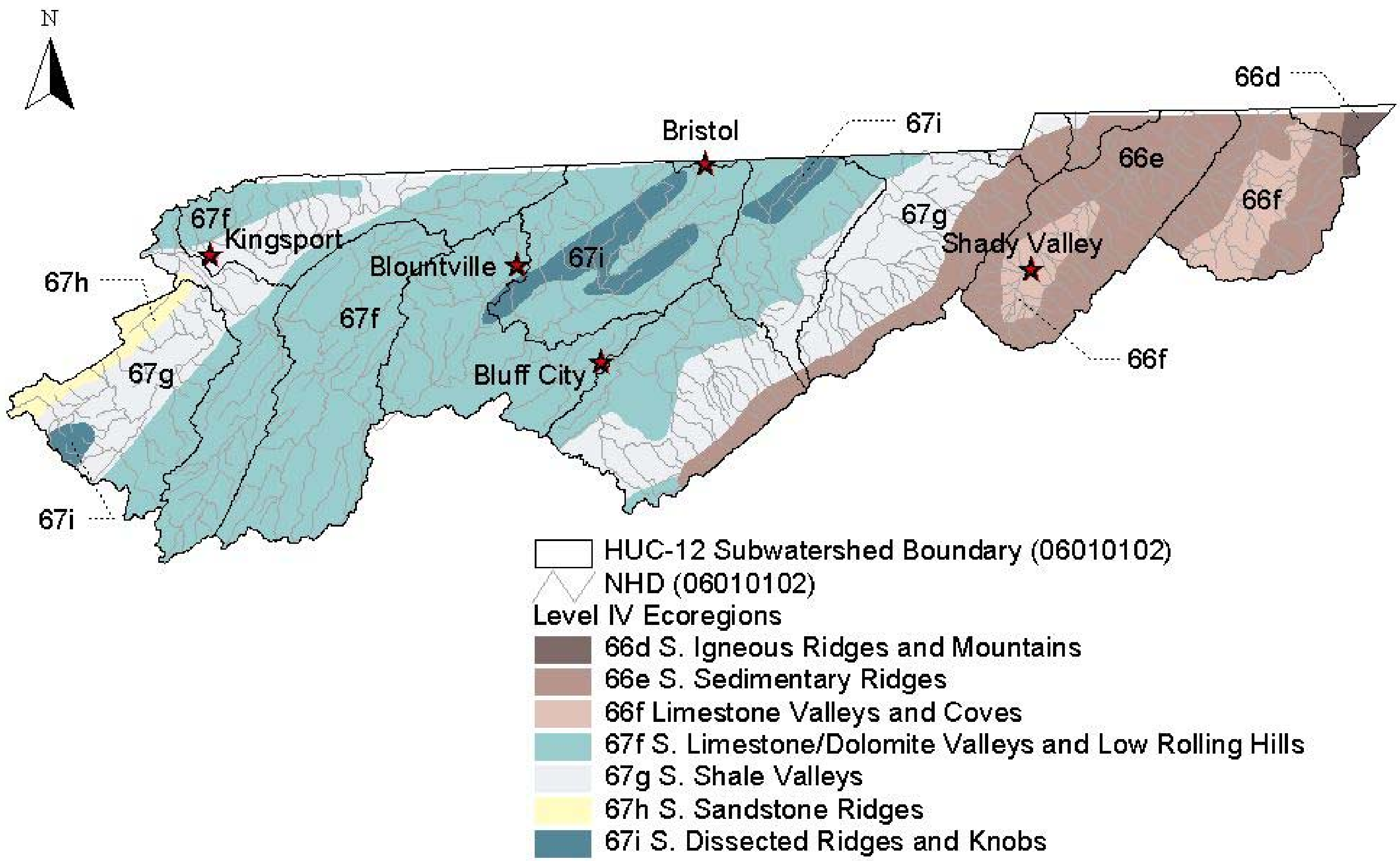


Table 1 Land Use Distribution - South Fork Holston River Watershed

Land Use	Area		
	[acres]	[mi^2]	[% of watershed]
Bare Rock/Sand/Clay	567	0.9	0.2
Deciduous Forest	173,473	271.1	48.7
Developed Open Space	29,872	46.7	8.4
Evergreen Forest	7,760	12.1	2.2
Grassland/Herbaceous	4,407	6.9	1.2
High Intensity Development	2,169	3.4	0.6
Low Intensity Development	15,907	24.9	4.5
Medium Intensity Development	4,468	7.0	1.3
Mixed Forest	6,381	10.0	1.8
Open Water	8,076	12.6	2.3
Pasture/Hay	98,114	153.3	27.5
Row Crops	2,937	4.6	0.8
Shrub/Scrub	1,804	2.8	0.5
Woody Wetlands	502	0.8	0.1
Total	**356,437**	**556.9**	**100.0**

Note: A spreadsheet was used for this calculation and values are approximate due to rounding.

3.0 PROBLEM DEFINITION

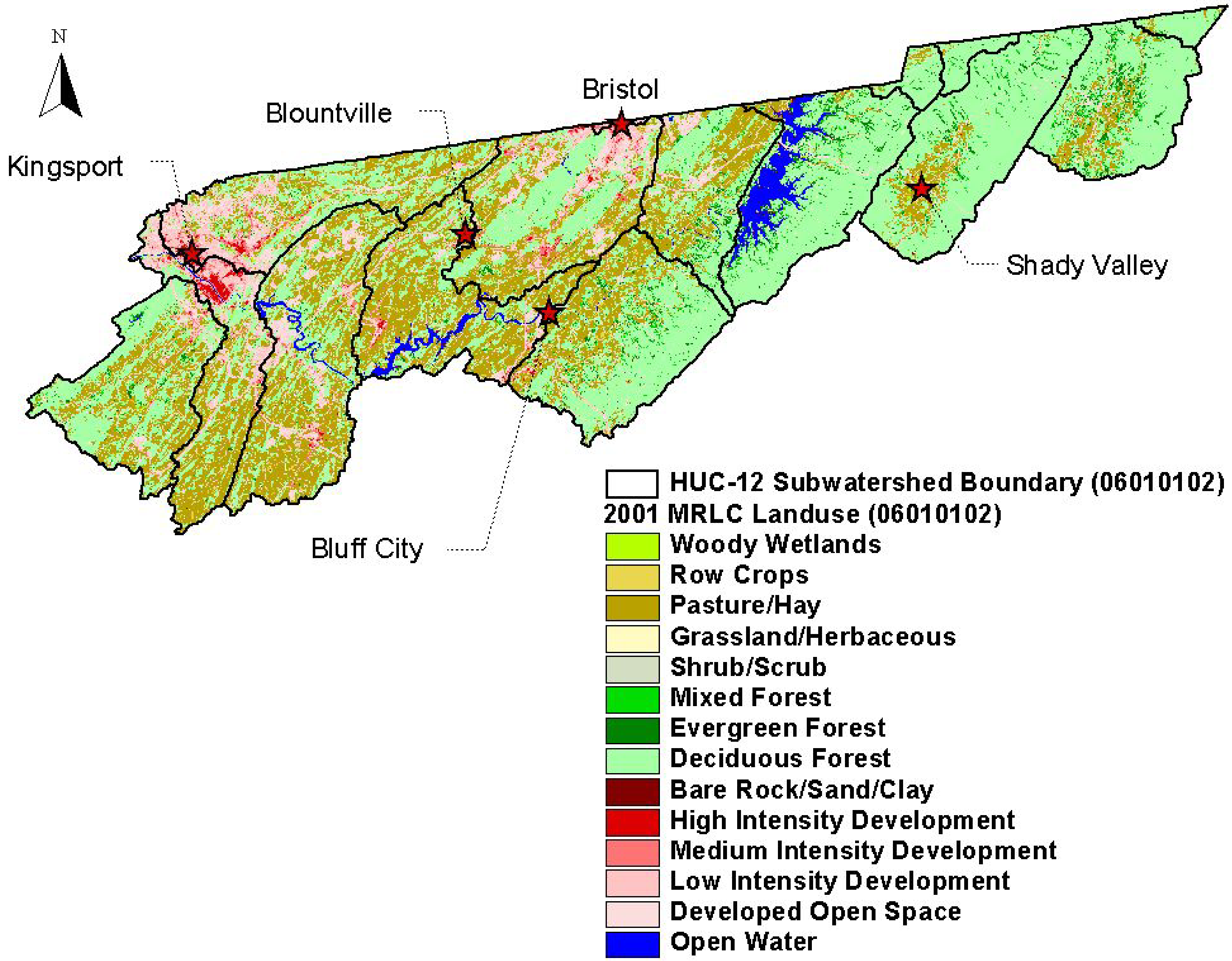
The State of Tennessee's *2004 303(d) List* (TDEC, 2005) identified a number of waterbodies in the South Fork Holston River Watershed as not fully supporting designated use classifications due, in part, to siltation and/or habitat alteration associated with agriculture, urban runoff, land development, and bank modification. These waterbodies are summarized in Table 2 and shown in Figure 4. The designated use classifications for the South Fork Holston River and its tributaries include fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in the watershed are also classified for domestic water supply, industrial water supply and/or trout stream (TDEC, 2004).

A description of the stream assessment process in Tennessee can be found in *2006 305(b) Report, The Status of Water Quality in Tennessee* (TDEC, 2006). This document states that "biological surveys using macroinvertebrates as the indicator organisms are the preferred method for assessing support of the fish & aquatic life designated use." The waterbody segments listed in Table 2 were assessed as impaired based primarily on biological surveys. The results of these assessment surveys are summarized in Table 3. The assessment information presented is excerpted from the ADB and is referenced to the waterbody IDs in Table 2. Assessment Database information may be accessed at:

http://gwidc.memphis.edu/website/dwpc/

An example of a typical stream assessment (Candy Creek at RM 1.7) is shown in Appendix A.

Figure 3 MRLC Land Use in the South Fork Holston River Watershed



Siltation is the process by which sediments are transported by moving water and deposited on the bottom of stream, river, and lakebeds. Sediment is created by the weathering of host rock and is delivered to stream channels through various erosional processes, including sheetwash, gully and rill erosion, wind, landslides, dry gravel, and human excavation. In addition, sediments are often produced as a result of stream channel and bank erosion and channel disturbance. Movement of eroded sediments downslope from their points of origin into stream channels and through stream systems is influenced by multiple interacting factors (USEPA, 1999).

Siltation (sedimentation) is the most frequently cited cause of waterbody impairment in Tennessee, impacting over 5,800 miles of streams and rivers (TDEC, 2006). Unlike many chemical pollutants, sediments are typically present in waterbodies in natural or background amounts and are essential to normal ecological function. Excessive sediment loading, however, is a major ecosystem stressor that can adversely impact biota, either directly or through changes to physical habitat.

Excessive sediment loading has a number of adverse effects on fish & aquatic life in surface waters. As stated in excerpts from *Developing Water Quality Criteria for Suspended and Bedded Sediments (SABS) – Draft* (USEPA, 2003):

> In streams and rivers, fine inorganic sediments, especially silts and clays, affect the habitat for macroinvertebrates and fish spawning, as well as fish rearing and feeding behavior. Larger sands and gravels can scour diatoms and cause burying of invertebrates, whereas suspended sediment affects the light available for photosynthesis by plants and visual capacity of animals.
>
> Sedimentation alters the structure of the invertebrate community by causing a shift in proportions from one functional group to another. Sedimentation can lead to embeddedness, which blocks critical macroinvertebrate habitat by filling in the interstices of the cobble and other hard substrate on the stream bottom. As deposited sediment increases, changes in invertebrate community structure and diversity occur.
>
> Invertebrate drift is directly affected by increased suspended sediment load in freshwater streams. These changes generally involve a shift in dominance from ephemeroptera, plecoptera and trichoptera (EPT) taxa to other less pollution-sensitive species that can cope with sedimentation. Increases in sediment deposition that affect the growth, abundance, or species composition of the periphytic (attached) algal community will also have an effect on the macroinvertebrate grazers that feed predominantly on periphyton. ……. Effects on aquatic individuals, populations, and communities are expressed through alterations in local food webs and habitat. When sedimentation exceeds certain thresholds, ensuing effects will likely involve decline of the existing aquatic invertebrate community and subsequent colonization by pioneer species.

Table 2 *2004 303(d) List* - Stream Impairment Due to Siltation/Habitat Alteration in the South Fork Holston River Watershed

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)
TN06010102001_0100	Madd Branch	2.7	Other Habitat Alterations	Discharges from MS4 area Channelization
TN06010102006T_0100	Gammon Creek	3.8	Habitat loss due to alteration in stream-side or littoral vegetative cover	Channelization Discharges from MS4 area
TN06010102006T_0200	Wagner Creek	5.5	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing Discharges from MS4 area
TN06010102006T_0300	Candy Creek	3.2	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing
TN06010102012_0100	Unnamed Trib To South Fork Holston River	2.0	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing
TN06010102012_0200	Paddle Creek	4.44	Habitat loss due to alteration in stream-side or littoral vegetative cover	Pasture Grazing
TN06010102012_0300	Unnamed Trib To South Fork Holston River	3.89	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing
TN06010102012_0700	Dry Creek	1.0	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Animal Feeding Operations (NPS)
TN06010102012_0810	Big Arm Branch	5.77	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Land Development Streambank Modification On-site Treatment Systems (Septic Tanks)
TN06010102042_0200	Back Creek	14.1	Nitrates/Loss of biological integrity due to siltation/Physical Substrate Habitat Alterations/Escherichia coli	Discharges from MS4 area Pasture Grazing/Livestock in Stream/Channelization

Table 2 (Cont.) ***2004 303(d) List*** **- Stream Impairment Due to Siltation/Habitat Alteration in the South Fork Holston River Watershed**

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)
TN06010102042_0500	Cedar Creek	11.8	Nitrates/Loss of biological integrity due to siltation/Other Anthropogenic Habitat Alterations/Escherichia coli	Discharges from MS4 Area Land Development
TN06010102042_2000	Beaver Creek	10.5	Habitat loss due to alteration in stream-side or littoral vegetative cover/Nitrates/Loss of biological integrity due to siltation/Escherichia coli	Channelization/Pasture Grazing/Discharges from MS4 Area/Sources Outside State Borders
TN06010102046_0100	Transbarger Branch	1.4	Other Anthropogenic Habitat Alterations	Discharges from MS4 Area
TN06010102046_1000	Reedy Creek	2.0	Loss of biological integrity due to siltation/Other Anthropogenic Habitat Alterations	Discharges from MS4 Area
TN06010102237_1000	Muddy Creek	12.3	Loss of biological integrity due to siltation/Other Habitat alterations	Pasture Grazing
TN060101020540_0800	Paint Spring Branch	1.0	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing

Figure 4 Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

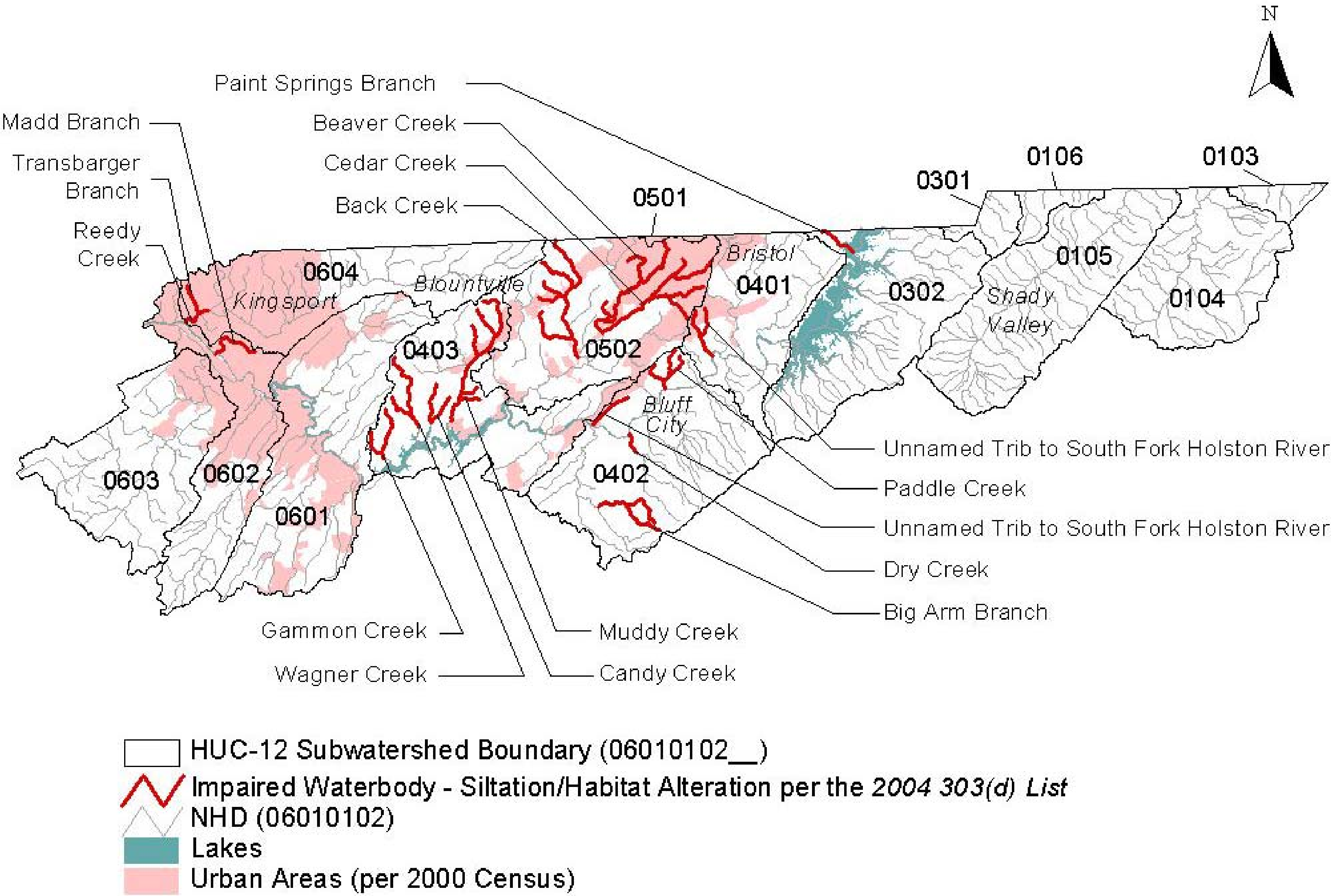


Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
TN06010102001_0100	Madd Branch (South Fork Holston River to headwaters, in Kingsport)	TDEC biological survey at mile 0.3 (near Lincoln Street). Zero EPT families, 11 total families. Habitat score = 127.
TN06010102006T_0100	Gammon Creek (Boone Reservoir to headwaters)	2003 TDEC chemical station and RBPIII at mile 07 (Minga Road). 4 EPT genera, 25 total genera. Index score = 26. Failed biocriteria. Habitat score = 120. 1998 TDEC biological survey at mile 0.7. 4 EPT families, 23 total families. Habitat score = 77. Habitat and EPT scores low, but total families O.K. Old TVA bacteria data.
TN06010102006T_0200	Wagner Creek (Boone Lake to headwaters)	2002 TDEC chemical station and RBPIII at mile 1.9 (u/s Holston Drive). 3 EPT genera, 11 total genera. BR score = 16. Habitat score = 127. 5 out of 9 E. coli observations over 1,000. 1998 TDEC biological station at mile 1.9. 5 EPT families, 17 total families, habitat score = 120. 1995 TVA data at mile 1.0. 3 EPT families. Fish IBI=20 (very poor)
TN06010102006T_0300	Candy Creek (Boone Reservoir to headwaters)	2002 TDEC chemical station and biorecon at mile 0.7 (Hawley Road). 2 EPT genera, 22 total genera. Index score = 18. Habitat score = 95. Four out of 9 E. coli observations over 1,000.
TN06010102012_0100	Unnamed Trib To South Fork Holston River (South Fork Holston to headwaters, at Silver Grove Road)	2003 TDEC biorecon and chemical station at mile 0.6 (Silver Grove Road). 6 EPT genera, 3 intolerant, 14 total genera. BR score = 3. Habitat score = 117. Three out of 8 E. coli observations over 1,000.

Table 3 (Cont.) Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
TN06010102012_0200	Paddle Creek (South Fork Holston to headwaters)	2003 TDEC biorecon and chemical station at mile 0.1 (Riverside Road). 8 EPT genera, 5 intolerant, 15 total genera. BR score = 5. Habitat score = 148.
TN06010102012_0300	Unnamed Trib To South Fork Holston River (South Fork Holston to headwaters)	2003 TDEC biorecon and chemical station at mile 0.7 (Bull Hollow Road). 3 EPT genera, 1 intolerant, 8 total genera. BR score = 3. Habitat score = 110. Seven out of 10 E. coli observations over 1,000.
TN06010102012_0700	Dry Creek (South Fork Holston to river mile 1.0)	2003 TDEC RBPIII at mile 1.0 (Chinkapin Road) and at mile 1.3 (Mount Holston Road). At mile 1.0: 10 EPT genera, 28 total genera. Failed biocriteria. Index score = 22. Habitat score = 139. All 9 E. coli observations over 2,000. 1999 TDEC station at mile 1.0 (Mt Holston Road). 12 EPT families, 23 total families, habitat score = 119.
TN06010102012_0810	Big Arm Branch (Indian Creek to headwaters)	2003 TDEC RBPIII and chemical station at mile 0.5 (Bunker Hill Road). 6 EPT genera, 29 total genera. Index score = 28. Habitat score = 105. Three out of 9 E. coli observations over 1,000.
TN06010102042_0200	Back Creek (Beaver Creek to headwaters, not including Unnamed Trib)	2003 TDEC RBPIII and chemical station at mile 0.5 (Exide Drive). 9 EPT genera, 34 total genera. Habitat score = 96. Four out of 11 E. coli observations over 1,000. 2003 TDEC RBPIII and chemical station at mile 3.1 (Carden Hollow Road). 4 EPT genera, 19 total genera. Index score = 32. Habitat score = 130. None out of 11 E. coli observations over 1,000. 1999 LAB biological survey at mile 0.5 (Exide Road). 2 EPT families (5 genera), 14 total families. Habitat score = 58. E. coli elevated (866). Cattle in creek. 1998 TDEC station at mile 0.6. 5 EPT families, 20 total families, habitat =95.
TN06010102042_0500	Cedar Creek (Beaver Creek to headwaters)	2003 TDEC RBPIII and chemical station at mile 0.3 (Grovedale Road). 4 EPT genera, 22 total genera. Index score = 28. Failed biocriteria. Habitat score = 96. Two out of 10 E. coli observations over 1,000. 1999 LAB biological survey at mile 0.3 (Grovedale Road). 3 EPT families (3 genera also), 15 total families. Habitat score = 92. E. coli elevated (980). 1999 TDEC station at mile 0.4. 6 EPT families, 16 total families, habitat score = 103.

Table 3 (Cont.) Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
TN06010102042_2000	Beaver Creek (confluence of Cedar Creek to Virginia state line)	Water contact advisory. 2003 TDEC RBPIII and chemical station at mile 11.0 (Roosterfront Park). 5 EPT genera, 24 total genera. Index score = 28. Habitat score = 157. Six out of 10 E. coli observations over 941. 2003 TDEC RBPIII and chemical station at mile 15.3 (near City Hall). 3 EPT genera, 26 total genera. Index score = 20. Habitat score = 84. Twenty out of 26 E. coli observations over 1,000. Multiple TDEC stations. 1998 USGS biorecon at mile 13.6 (u/s Cedar Creek). 6 EPT genera, 18 total genera. Passed biorecon criteria. 1995 TVA biological survey at mile 17.6 (7 EPT families).
TN06010102046_0100	Transbarger Branch (Reedy Creek to headwaters)	TDEC biological survey at mile 0.8 (behind Holiday Inn). 2 EPT families, 9 total families. Habitat score = 117
TN06010102046_1000	Reedy Creek (South Fork Holston River to unnamed tributary near Bloomington Heights)	TDEC biological survey at mile 0.4 (behind athletic field). Zero EPT families, 11 total families. Habitat score = 154. 1998 USGS biorecon at mile 2.5 at Germantown. 2 EPT genera, 2 intolerant, 23 total genera. Failed biorecon criteria.
TN06010102237_1000	Muddy Creek (South Fork Holston to headwaters)	Stream appears to have improved since last assessment. 2003 TDEC RBPIII and chemical station at mile 0.7 (Spangler Road). 8 EPT genera, 17 total genera. Index score = 36. Habitat score = 131. One out of 9 E. coli observations over 1,000. 2003 TDEC RBPIII and chemical station at mile 4.3 (Camp Placid Road). 8 EPT genera, 19 total genera. Index score = 32. Habitat score = 126. One out of 9 E. coli observations over 1,000. 2003 TDEC RBPIII and chemical station at mile 6.7 (Massingill Road). 10 EPT genera, 30 total genera. Index score = 32. Habitat score = 116. Two out of 9 E. coli observations over 1,000. 1999 LAB biological survey at mile 0.7 (Spangler Road). 2 EPT families (2 genera also), 14 total families. Habitat score = 117. 1998 TDEC station at mile 0.7 (Muddy Road Church). 5 EPT families, 16 total families, habitat score = 154.
TN060101020540_0800	Paint Spring Branch (South Holston Reservoir to headwaters)	2003 TDEC RBPIII and chemical station at mile 0.4 (Paint Spring Road). 2 EPT genera, 23 total genera. Index score = 24. Habitat score = 78. Five out of 10 E. coli observations over 1,000.

Historically, waterbodies in Tennessee have been assessed as not fully supporting designated uses due to siltation when the impairment was determined to be the result of excess loading of the inorganic sediment produced by erosional processes. In cases where impairment was determined to be caused by excess loading of the primarily organic particulate material found in sewage treatment plant (STP) effluent, the cause of pollution was listed as total suspended solids (TSS) or organic enrichment. In consideration of this practice, this document presents the details of TMDL development for waterbodies in the South Fork Holston River Watershed listed as impaired due to siltation (excess inorganic sediment produced by erosional processes) and/or appropriate cases of habitat alteration. The TSS in STP effluent is considered to be a distinctly different pollutant and, therefore, is excluded in sediment loading calculations.

4.0 TARGET IDENTIFICATION

Several narrative criteria, applicable to siltation/habitat alteration, are established in *Rules of Tennessee Department of Environment and Conservation, Tennessee Water Quality Control Board, Division of Water Pollution Control, Chapter 1200-4-3 General Water Quality Criteria, January, 2004* (TDEC, 2004a):

Applicable to all use classifications (Fish & Aquatic Life shown):

> Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish & aquatic life.
>
> Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):

> Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish & aquatic life.

Applicable to the Fish & Aquatic Life use classification:

> Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.
>
> Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion and (b) is of the appropriate stream order specified for the bioregion, and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.
>
> Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable

Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.

Habitat - The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

These TMDLs are being established to attain full support of the fish & aquatic life designated use classification. TMDLs established to protect fish & aquatic life will protect all other use classifications for the identified waterbodies from adverse alteration due to sediment loading.

In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where State regulation does not provide a numeric water quality criteria, as in the case of siltation/habitat alteration, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of these TMDLs, the average annual sediment loading in lbs/acre/yr, from a biologically healthy watershed, located within the same Level IV ecoregion as the impaired watershed, is determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish & aquatic life. Biologically healthy watersheds were identified from the State's ecoregion reference sites. These ecoregion reference sites have similar characteristics and conditions as the majority of streams within that ecoregion. Detailed information regarding Tennessee ecoregion reference sites can be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC, 2000). In general, land use in ecoregion reference watersheds consist of less pasture, cropland, and urban areas and more forested areas compared to the impaired watersheds. The biologically healthy (reference) watersheds are considered the "least impacted" in an ecoregion and, as such, sediment loading from these watersheds may serve as an appropriate target for the TMDL.

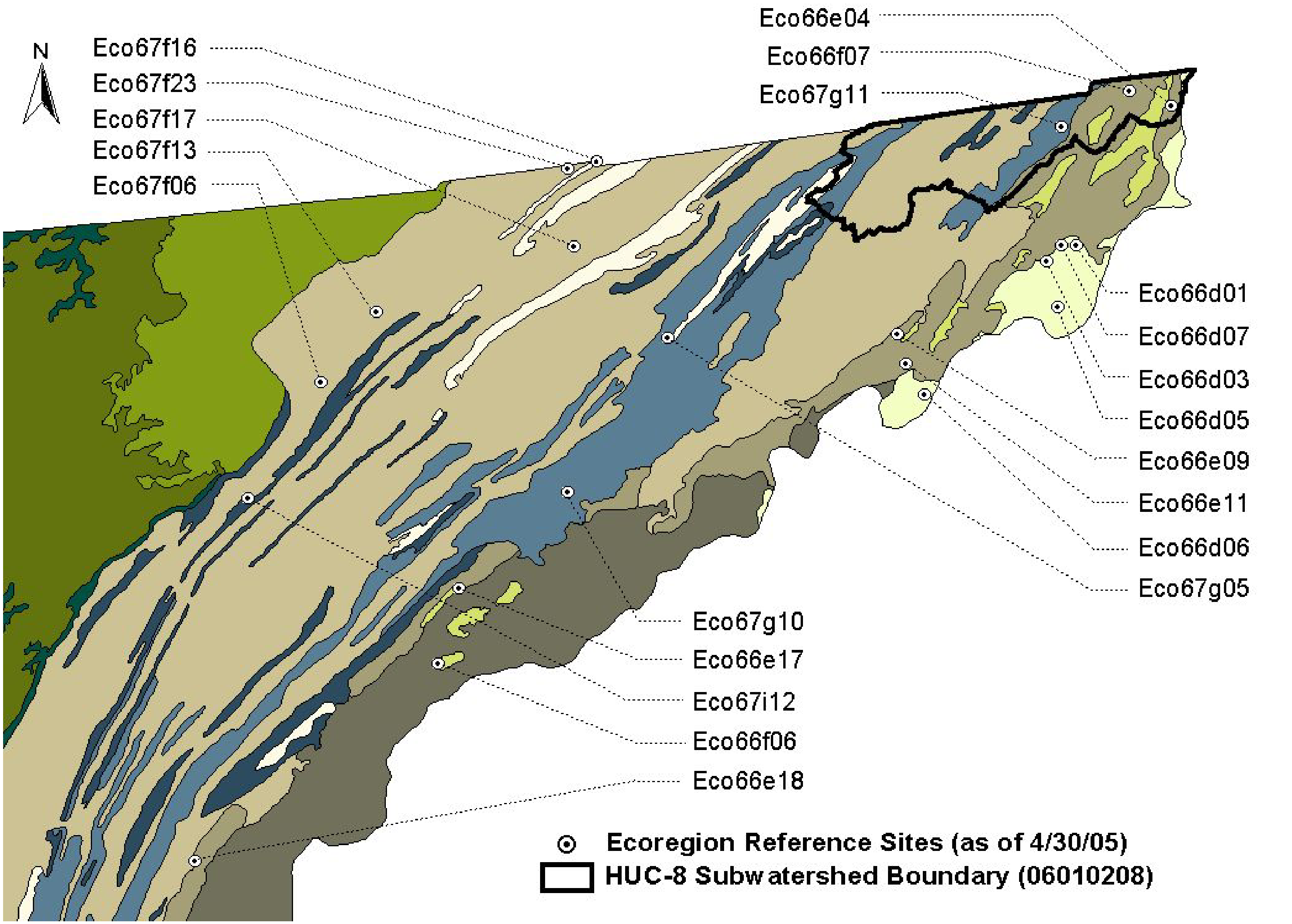
Using the methodology described in Appendix B, the Watershed Characterization System (WCS) Sediment Tool was used to calculate the average annual sediment load for each of the biologically healthy (reference) watersheds in Level IV ecoregions 66d, 66e, 66f, 67f, 67g, 67h, and 67i. The geometric mean of the average annual sediment loads of the reference watersheds in each Level IV ecoregion was selected as the most appropriate target for that ecoregion. Since the impairment of biological integrity due to sediment build-up is generally a long-term process, using an average annual load is considered appropriate. The average annual sediment loads for reference sites and corresponding TMDL target values for Level IV ecoregions 66d, 66e, 66f, 67f, 67g, 67h, and 67i are summarized in Table 4. Reference site locations are shown in Figure 5.

Note: Ecoregion reference sites are continually reviewed, with sites added or deleted as circumstances warrant. Using the methodology described in Appendix B, the WCS Sediment Tool was used to determine the average annual sediment loads, due to precipitation-based sources, for the active Level IV ecoregion reference sites as of April 30, 2005. The WCS sediment tool utilizes DEM and MRLC coverages to calculate the sediment loads. The stations listed in Table 4 and shown in Figure 5 are the ecoregion reference sites as of April 30, 2005 for which the average annual sediment loads could be calculated with current information.

Table 4 Average Annual Sediment Loads of Level IV Ecoregion Reference Sites

Level 4 Ecoregion	Reference Site	Stream	Drainage Area [acres]	Average Annual Sediment Load [lbs/acre/year]
66d	Eco66d01	Black Branch	760	234.5
	Eco66d03	Laurel Fork Creek	11,163	189.2
	Eco66d05	Doe River	593	21.4
	Eco66d06	Tumbling Creek	645	23.6
	Eco66d07	Little Stony Creek	1,541	231.2
			Geometric Mean (Target Load)	**87.7**
66e	Eco66e04	Gentry Creek	2,715	35.7
	Eco66e09	Clark Creek	5,890	147.0
	Eco66e11	Lower Higgins Creek	2,186	40.9
	Eco66e17	Double Branch	1,881	143.1
	Eco66e18	Gee Creek	2,732	135.8
			Geometric Mean (Target Load)	**84.0**
66f	Eco66f06	Abrams Creek	13,859	147.1
	Eco66f07	Beaverdam Creek	29,258	201.8
			Geometric Mean (Target Load)	**172.3**
67f	Eco67f06	Clear Creek	1,976	490.3
	Eco67f13	White Creek	1,725	421.4
	Eco67f16	Hardy Creek	26,976	184.8
	Eco67f17	Big War Creek	30,063	490.1
	Eco67f23	Martin Creek	15,160	314.5
			Geometric Mean (Target Load)	**358.1**
67g	Eco67g05	Bent Creek	21,064	270.7
	Eco67g10	Flat Creek	13,237	482.9
	Eco67g11	N Prong Fishdam Creek	1,019	770.9
			Geometric Mean (Target Load)	**465.4**
67i	Eco67i12	Mill Branch	681	**235.7**

Figure 5 Reference Sites in Level IV Ecoregions 66d, 66e, 66f, 67f, 67g, 67h, and 67i



5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Using the methodology described in Appendix B, the WCS Sediment Tool was used to determine the average annual sediment load, due to precipitation-based sources, for all HUC-12 subwatersheds in the South Fork Holston River Watershed (ref.: Figure 4). Existing precipitation-based sediment loads for subwatersheds with waterbodies listed on the *2004 303(d) List* as impaired for siltation/habitat alteration are summarized in Table 5.

Table 5 Existing Sediment Loads in Subwatersheds with Impaired Waterbodies

HUC-12 Subwatershed (06010102____)	Level IV Ecoregion	Existing Sediment Load
		[lbs/ac/yr]
0302	66e	2,108
0401	67f	517
0402		422
0403		392
0502	67i	649
0602	67f	691
0604		708

6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of siltation in the watershed and the amount of pollutant loading contributed by each of these sources. Under the Clean Water Act, sources are broadly classified as either point or nonpoint sources. Under 40 CFR 122.2, a point source is defined as a discernable, confined and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Regulated point sources include: 1) municipal and industrial wastewater treatment facilities (WWTFs); 2) storm water discharges associated with industrial activity (which includes construction activities); and 3) certain discharges from Municipal Separate Storm Sewer Systems (MS4s). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point sources. For the purposes of these TMDLs, all sources of sediment loading not regulated by NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

6.1 Point Sources

6.1.1 NPDES Regulated Wastewater Treatment Facilities

As stated in Section 3.0, the TSS component of STP discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced from erosional processes. Therefore, TSS discharges from STPs are not included in the TMDLs developed for this document.

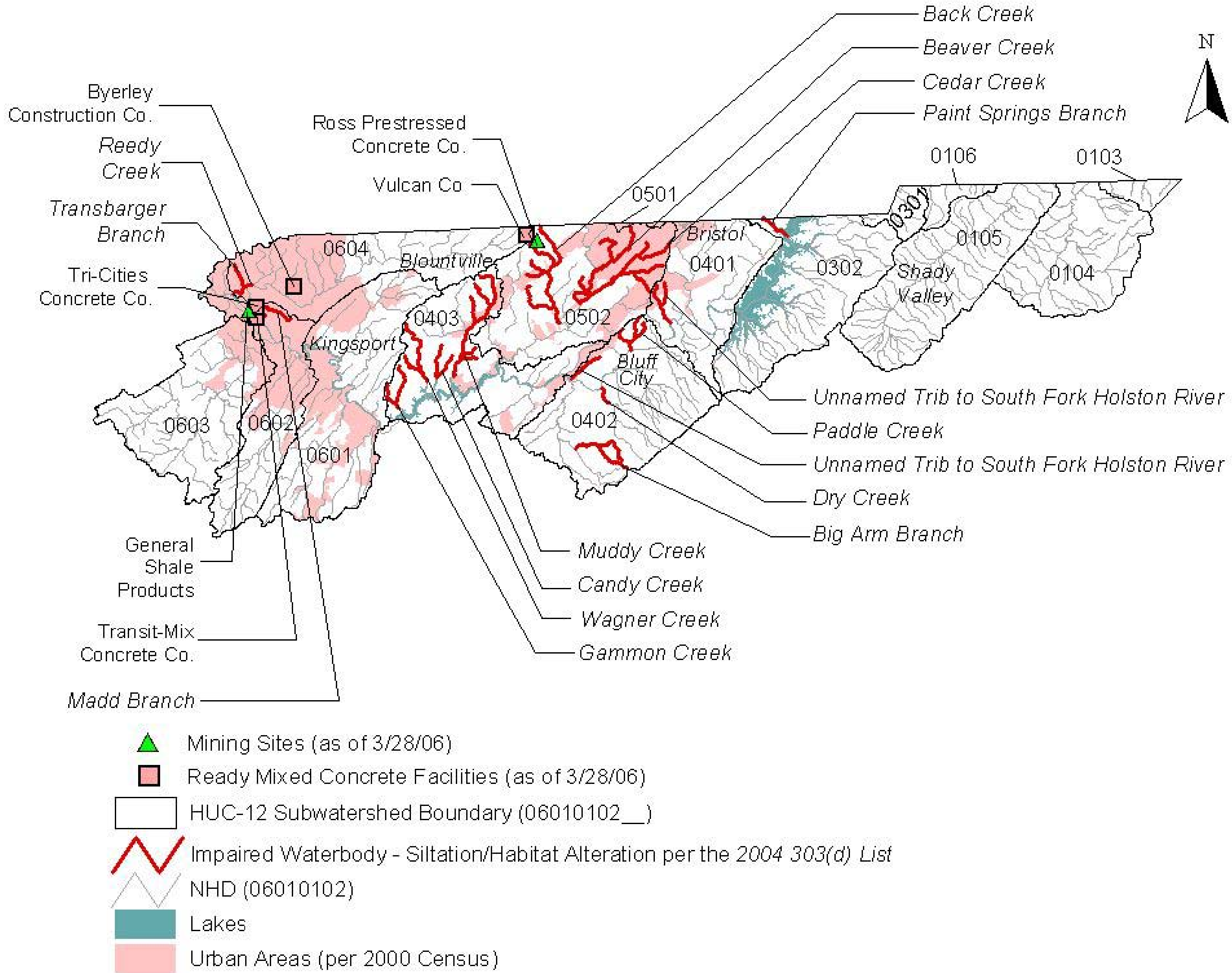
6.1.2 NPDES Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS discharges (TSS discharged from RMCFs is composed of primarily inorganic material and is therefore included as a source for TMDL development). Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003). This permit establishes a daily maximum TSS concentration limit of 50 mg/l on process wastewater effluent and specifies monitoring procedures for storm water discharges. Facilities are also required to develop and implement storm water pollution prevention plans (SWPPPs). Discharges from RMCFs are generally intermittent, and contribute a small portion of total sediment loading to HUC-12 subwatersheds (ref.: Appendix D). In some cases, for discharges into impaired waters, sites may be required to obtain coverage under an individual NPDES permit. Of the six permitted RMCFs in the South Fork Holston River Watershed as of March 28, 2006, four are located in impaired subwatersheds. These facilities are listed in Table 6 and shown in Figure 6.

Table 6 NPDES Regulated Ready Mixed Concrete Facilities Located in Impaired Subwatersheds (as of March 28, 2006)

HUC-12 Subwatershed (06010102___)	NPDES Permit No.	Facility Name	TSS Daily Max Limit [mg/l]	TSS Cut-off Conc. (SW Discharge) [mg/l]
0602	TNG110297	Transit-Mix Concrete Company	50	200
0604	TNG110123	Tri-Cities Concrete Co., Inc.		
	TNG110140	Byerley Const. Co. Inc.		
	TNG110249	Ross Prestressed Concrete Co., Inc.		

Figure 6 NPDES Regulated RMCFs and Mining Sites Located in Impaired Subwatersheds



6.1.3 NPDES Regulated Mining Sites

Discharges from regulated mining activities may contribute sediment to surface waters as TSS (TSS discharged from mining sites is composed of primarily inorganic material and is therefore included as a source for TMDL development). Discharges from active mines may result from dewatering operations and/or in response to storm events, whereas discharges from permitted inactive mines are only in response to storm events. Inactive sites with successful surface reclamation contribute relatively little solids loading. Of the three permitted mining sites in the South Fork Holston River Watershed (as of March 28, 2006), two are located in impaired subwatersheds. These are listed in Table 7 and shown in Figure 6. Sediment loads (as TSS) to waterbodies from mining site discharges are very small in relation to total sediment loading (ref.: Appendix D).

Table 7 NPDES Regulated Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds (as of March 28, 2006)

HUC-12 Subwatershed (06010102___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0502	TN0064157	Vulcan Construction Materials, LP	40
0602	TN0054445	General Shale Products, LLC	

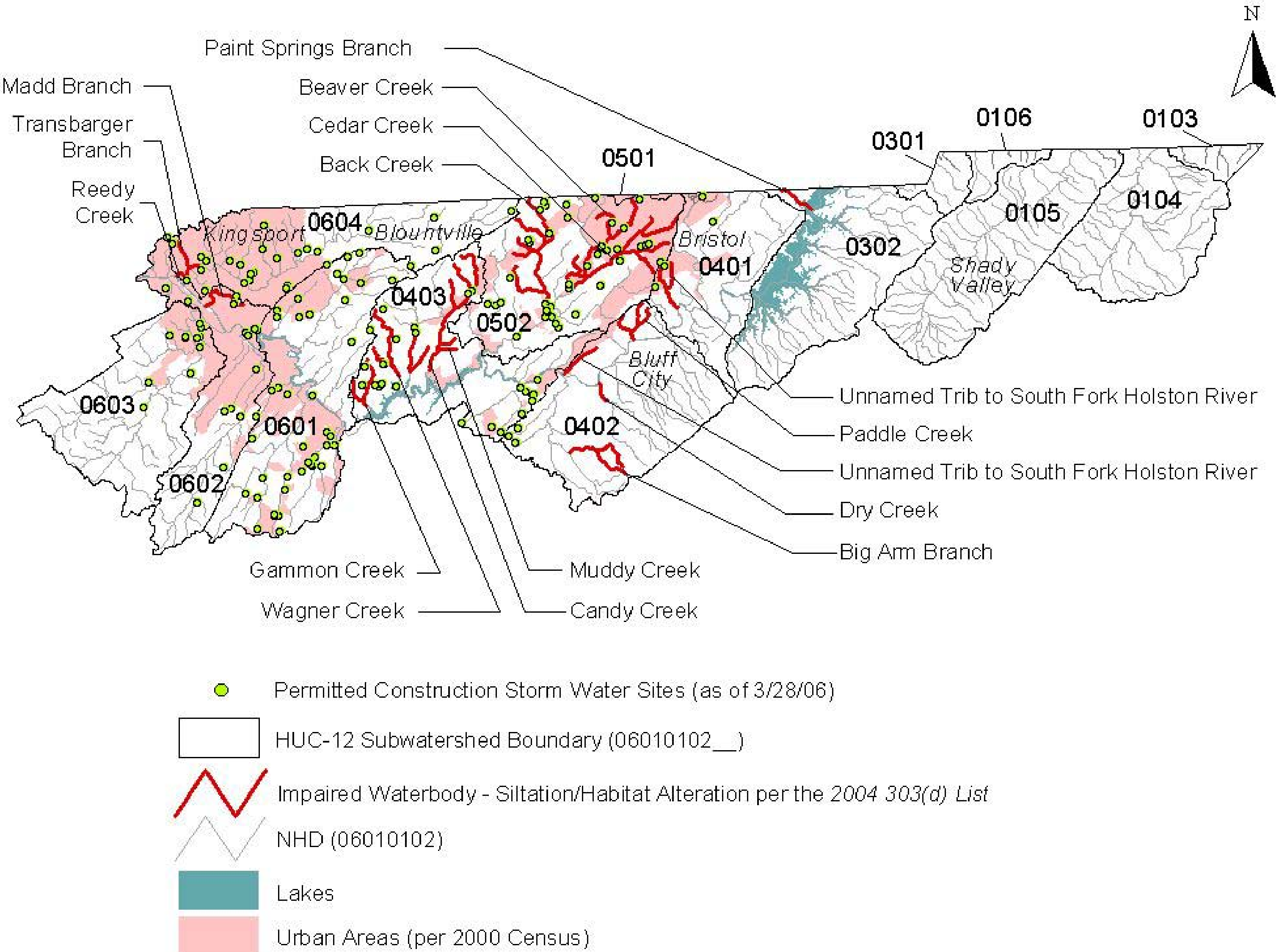
6.1.4 NPDES Regulated Construction Activities

Discharges from NPDES regulated construction activities are considered point sources of sediment loading to surface waters and occur in response to storm events. Currently, discharges of storm water from construction activities disturbing an area of one acre or more must be authorized by an NPDES permit. Most of these construction sites obtain coverage under NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a). Since construction activities at a site are of a temporary, relatively short-term nature, the number of construction sites covered by the general permit at any instant of time varies. Of the 171 permitted active construction storm water sites in the South Fork Holston River Watershed on March 28, 2006, 117 were in impaired subwatersheds (ref.: Figure 7).

6.1.5 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

MS4s may discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and wash-off of accumulated street dust and litter from impervious surfaces during rain events. Phase I of the EPA storm water program requires large and medium MS4s to obtain NPDES storm water permits. Large and medium MS4s are those located in incorporated places or counties serving populations greater than 100,000 people. At present, there are no Phase I MS4s in the South Fork Holston River Watershed.

Figure 7 Location of NPDES Permitted Construction Storm Water Sites in the South Fork Holston River Watershed



As of March 2003, regulated small MS4s in Tennessee must also obtain NPDES permits in accordance with the Phase II storm water program. A small MS4 is designated as *regulated* if: a) it is located within the boundaries of a defined urbanized area that has a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile; b) it is located outside of an urbanized area but within a jurisdiction with a population of at least 10,000 people, a population density of 1,000 people per square mile, and has the potential to cause an adverse impact on water quality; or c) it is located outside of an urbanized area but contributes substantially to the pollutant loadings of a physically interconnected MS4 regulated by the NPDES storm water program. Most regulated small MS4s in Tennessee obtain coverage under the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a). There are five permitted Phase II MS4s in the South Fork Holston River Watershed:

NPDES Permit Number	Phase	Permittee Name
TNS077615	II	Lewisburg
TNS075531	II	Shelbyville
TNS077631	II	Tullahoma
TNS075647	II	Rutherford County
TNS075795	II	Williamson County

The Tennessee Department of Transportation (TDOT) has been issued an individual MS4 permit (TNS077585) that authorizes discharges of storm water runoff from State road and interstate highway right-of-ways that TDOT owns or maintains, discharges of storm water runoff from TDOT owned or operated facilities, and certain specified non-storm water discharges. This permit covers all eligible TDOT discharges statewide, including those located outside of urbanized areas.

Information regarding storm water permitting in Tennessee may be obtained from the TDEC website at http://www.state.tn.us/environment/wpc/stormh2o/.

6.2 Nonpoint Sources

Nonpoint sources account for the vast majority of sediment loading to surface waters. These sources include:

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.

- Erosion from agricultural activities can be a major source of sedimentation due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.

- Urban erosion from bare soil areas under construction and washoff of accumulated street dust and litter from impervious surfaces.

- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. It occurs when soil particles are loosened and carried away from the roadway, ditch, or road bank by water, wind, or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface and/or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or "turn-outs" from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion. Exposed soils, high runoff velocities and volumes and poor road compaction all increase the potential for erosion.

- Runoff from abandoned mines may be significant sources of solids loading. Mining activities typically involve removal of vegetation, displacement of soils, and other significant land disturbing activities.

- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little soil erosion.

For impaired waterbodies within the South Fork Holston River Watershed, the primary sources of nonpoint sediment loads come from agriculture, roadways, and urban sources. The watershed land use distribution based on the 2001 MRLC satellite imagery databases is shown in Appendix C for impaired HUC-12 subwatersheds.

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations) and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

TMDL analyses are performed on a 12-digit hydrologic unit code (HUC-12) area basis for subwatersheds containing waterbodies identified as impaired due to siltation and/or habitat alteration on the *2004 303(d) List*. HUC-12 subwatershed boundaries are shown in Figure 4.

7.1 Analysis Methodology

Sediment analysis for watersheds can be conducted using methods ranging from simple, gross estimates to complex dynamic loading and receiving water models. The choice of methodology is dependent on a number of factors that include watershed size, type of impairment, type and quantity of data available, resources available, time, and cost. In consideration of these factors, the following approach was selected as the most appropriate for sediment TMDLs in the South Fork

Holston River Watershed.

Sediment loading analysis for waterbodies impaired due to siltation/habitat alteration in the South Fork Holston River Watershed was accomplished using the Watershed Characterization System (WCS) Sediment Tool. This ArcView geographic information system (GIS) based model is described in Appendix B and was utilized according to the following procedure:

- The Watershed Characterization System (WCS) Sediment Tool was used to determine sediment loading to Level IV ecoregion reference site watersheds. These are considered to be biologically healthy watersheds. The average annual sediment loads in lbs/acre/yr of these reference watersheds serve as target values for the South Fork Holston River Watershed sediment TMDLs.

- The Sediment Tool was also used to determine the existing average annual sediment loads of impaired watersheds located in the same Level IV ecoregion. Impaired watersheds are defined as 12-digit HUCs containing one or more waterbodies identified as impaired due to siltation/habitat alteration on the State's *2004 303(d) List* (ref.: Figure 4).

- The existing average annual sediment load of each impaired HUC-12 subwatershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed and an overall required percent reduction in loading calculated. For each impaired HUC-12 subwatershed, the TMDL is equal to this overall required reduction:

$$\text{TMDL} = \frac{(\text{Existing Load}) - (\text{Target Load})}{(\text{Existing Load})} \times 100$$

  Although the Sediment Tool uses the best road, elevation, and land use GIS coverages available, the resulting average annual sediment loads should not be interpreted as an absolute value. The calculated loading reductions, however, are considered to be valid since they are based on the relative comparison of loads calculated using the same methodology.

- In each impaired subwatershed, 5% of the ecoregion-based target load was reserved to account for WLAs for NPDES permitted RMCFs and mining sites. The existing loads from these facilities are less than the five percent reserved in each impaired HUC-12 subwatershed. Any difference between these existing loads and the 5% reserved load provide for future growth and additional MOS (ref.: Appendix D).

- For each impaired HUC-12 subwatershed, WLAs for construction storm water sites, WLAs for MS4s, and LAs for nonpoint sources were considered to be the percent load reduction required to decrease the existing annual average sediment load to a level equal to 95% of the target value.

$$\text{WLA}_{\text{Const. SW}} = \text{WLA}_{\text{MS4}} = \text{LA} = \frac{(\text{Existing Load}) - [(.95)\ (\text{Target Load})]}{(\text{Existing Load})} \times 100$$

- TMDLs, WLAs for construction storm water sites and MS4s, and LAs are expressed as a percent reduction in average annual sediment loading. WLAs for RMCFs and mining sites are equal to loads authorized by their existing permits. Since sediment loading from RMCFs and mining sites are small with respect to storm water induced sediment loading for all subwatersheds, further reductions from these facilities were not considered warranted (ref.: Appendix D).

It is expected that the reduction of sediment loading as specified by WLAs and LAs in impaired watersheds will result in the attainment of fully supporting status for all designated use classifications, with respect to siltation/habitat alteration. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measure.

Details of the analysis methodology are more fully described in Appendix B. This approach is recognized as an acceptable alternative to a maximum allowable mass load per day in the *Protocol for Developing Sediment TMDLs* (USEPA, 1999).

7.2 TMDLs for Impaired Subwatersheds

Sediment TMDLs for subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration are summarized in Table 8.

7.3 Waste Load Allocations

7.3.1 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

Of the six Ready Mixed Concrete Facilities (RMCFs) in the South Fork Holston River Watershed with NPDES permits, four are located in impaired subwatersheds (ref.: Table 6 and Figure 6). Since sediment loading from RMCFs located in impaired subwatersheds is small (ref.: Appendix D) compared to the total loading for impaired subwatersheds, the WLAs are considered to be equal to the existing permit requirements for these facilities.

7.3.2 Waste Load Allocations for NPDES Regulated Mining Activities

Of the three mining sites in the South Fork Holston River Watershed with NPDES permits, two are located in impaired subwatersheds (ref.: Table 7 and Figure 6). Since sediment loading from mining sites located in impaired subwatersheds is small (ref.: Appendix D) compared to the total loading for impaired subwatersheds, the WLAs are considered to be equal to the existing permit requirements for these sites.

Table 8 Sediment TMDLs for Subwatersheds with Waterbodies Impaired for Siltation/Habitat Alteration

HUC-12 Subwatershed (06010102___)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	Existing Sediment Load	Target Load	TMDL (required load reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0302	060101020540_0800	Paint Spring Branch	66e	2,108	84.0	96.0
0401	06010102012_0300	Unnamed Trib To South Fork Holston River	67f	517	358.1	30.8
0402	06010102012_0100	Unnamed Trib To South Fork Holston River	67f	422	358.1	15.1
	06010102012_0200	Paddle Creek				
	06010102012_0700	Dry Creek				
	06010102012_0810	Big Arm Branch				
0403	06010102006T_0100	Gammon Creek	67f	392	358.1	8.6
	06010102006T_0200	Wagner Creek				
	06010102006T_0300	Candy Creek				
	06010102237_1000	Muddy Creek				
0502	06010102042_0200	Back Creek	67i	649	235.7	63.7
	06010102042_0500	Cedar Creek				
	06010102042_2000	Beaver Creek				
0602	06010102001_0100	Madd Branch	67f	691	358.1	48.2
0604	06010102046_0100	Transbarger Branch	67f	708	358.1	49.5
	06010102046_1000	Reedy Creek				

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration.

7.3.3 Waste Load Allocations for NPDES Regulated Construction Activities

Point source discharges of storm water from construction activities (including clearing, grading, filling, excavating, or similar activities) that result in the disturbance of one acre or more of total land area must be authorized by an NPDES permit. Since these discharges have the potential to transport sediment to surface waters, WLAs are provided for this category of activities. WLAs are established for each subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9). WLAs provided to NPDES regulated construction activities will be implemented as Best Management Practices (BMPs), as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y (TDEC, 2005a). WLAs should not be construed as numeric permit limits.

Table 9 Summary of WLAs for MS4s and Construction Storm Water Sites and LAs for Nonpoint Sources

HUC-12 Subwatershed (06010102__)	Level IV Ecoregion	Percent Reduction – Average Annual Sediment Load	
		WLAs (Construction SW and MS4s)	LAs (Nonpoint Sources)
		[%]	[%]
0302	66e	96.2	96.2
0401	67f	34.2	34.2
0402		19.3	19.3
0403		13.2	13.2
0502	67i	65.5	65.5
0602	67f	50.7	50.7
0604		52.0	52.0

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration.

7.3.4 Waste Load Allocations for NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal separate storm sewer systems (MS4s) are regulated by the State's NPDES program (ref.: Section 6.1.5). Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading (minus the 5% allocated to RMCFs and regulated mining sites) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9). WLAs apply to MS4 discharges in the impaired subwatershed for which the WLA was developed and will be implemented as Best Management Practices (BMPs) as specified in Phase I and II MS4 permits. WLAs should not be construed as numeric limits.

7.4 Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in these TMDLs. LAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref.: Table 2). LAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9).

7.5 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was incorporated through the use of conservative modeling assumptions. These include:

- Target values based on Level IV ecoregion reference sites. These sites represent the least impacted streams in the ecoregion.

- The use of the sediment delivery process that results in the most sediment transport to surface waters (Method 2 in Appendix B).

In most presently impaired subwatersheds, some amount of explicit MOS is realized due to the WLAs specified for NPDES permitted RMCFs and mining sites being less than the 5% of the target load reserved for these facilities.

7.6 Seasonal Variation

Sediment loading is expected to fluctuate according to the amount and distribution of rainfall. The determination of sediment loads on an average annual basis accounts for these differences through the rainfall erosivity index in the USLE (ref.: Appendix B). This is a statistic calculated from the annual summation of rainfall energy in every storm and its maximum 30-minute intensity.

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES Regulated Ready Mixed Concrete Facilities

Four of the six NPDES regulated RMCFs in the South Fork Holston River Watershed are located in impaired subwatersheds (ref.: Table 6 and Figure 6). WLAs will be implemented through NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003).

8.1.2 NPDES Regulated Mining Sites

Two of the three NPDES regulated mining sites in the South Fork Holston River Watershed are located in impaired subwatersheds (ref.: Table 7 and Figure 6). WLAs will be implemented through the existing permit requirements for these sites.

8.1.3 NPDES Regulated Construction Storm Water

The WLAs provided to existing and future NPDES regulated construction activities will be implemented through Best Management Practices (BMPs) as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a). The permit requires the development and implementation of a site-specific Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of construction activities. The SWPPP must be prepared in accordance with good engineering practices and the latest edition of the *Tennessee Erosion and Sediment Control Handbook* (TDEC, 2002) and must identify potential sources of pollution at a construction site that would affect the quality of storm water discharges and describe practices to be used to reduce pollutants in those discharges. At a minimum, the SWPPP must include the following elements:

- Site description
- Description of storm water runoff controls
- Erosion prevention and sediment controls
- Storm water management
- Description of items needing control
- Approved local government sediment and erosion control requirements
- Maintenance
- Inspections
- Pollution prevention measures for non-storm water discharges
- Documentation of permit eligibility related to TMDLs

The SWPPP must include documentation supporting a determination of permit eligibility with regard to waters that have an approved TMDL for a pollutant of concern, including:

- identification of whether the discharge is identified, either specifically or generally, in an approved TMDL and any associated allocations, requirements, and assumptions identified for the discharge;

- summaries of consultation with the division on consistency of SWPPP conditions with the approved TMDL; and

- measures taken to ensure that the discharge of pollutants from the site is consistent with the assumptions and requirements of the approved TMDL, including any specific wasteload allocation that has been established that would apply to the discharge.

The permit does not authorize discharges that would result in a violation of a State water quality standard. In addition, a number of special requirements are specified for discharges entering high quality waters or waters identified as impaired due to siltation. These additional requirements include:

- The SWPPP must certify that erosion and sediment controls are designed to control runoff from a 5-year, 24-hour storm event.
- More frequent (twice weekly) inspections of erosion and sediment controls.
- If a discharger is complying with the SWPPP, but is contributing to the impairment of a stream, the SWPPP must be revised and implemented to eliminate further impairment to the stream. If these changes are not implemented within seven days of receipt of notification, coverage under the general permit will be terminated and continued discharges covered under an individual permit. The construction project must be stabilized until the revised SWPPP is implemented or an individual permit issued. No earth disturbing activities, except for stabilization, are authorized until the individual permit is issued.
- For an outfall in a drainage area of a total of five or more acres, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 5-year, 24-hour storm and runoff from each acre drained, or equivalent control measures, shall be provided until final stabilization of the site.
- A 60-foot natural riparian buffer zone adjacent to a receiving stream designated as impaired or high quality waters must be preserved, to the maximum extent practicable, during construction activities at the site.

Strict compliance with the provisions of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a) can reasonably be expected to achieve reduced sediment loads to streams. The primary challenge for the reduction of sediment loading from construction sites to meet TMDL WLAs is in the effective compliance monitoring of all requirements specified in the permit and timely enforcement against construction sites not found to be in compliance with the permit.

8.1.4 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

For existing and future regulated discharges from municipal separate storm sewer systems (MS4s), WLAs will be implemented through Phase I and II MS4 permits. These permits will require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. Both the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a) and the TDOT individual MS4 permit (TNS077585) require SWMPs to include the following six minimum control measures:

1) Public education and outreach on storm water impacts;
2) Public involvement/participation;
3) Illicit discharge detection and elimination;
4) Construction site storm water runoff control;

5) Post-construction storm water management in new development and re-development;

6) Pollution prevention/good housekeeping for municipal (or TDOT) operations.

The permits also contain requirements regarding control of discharges of pollutants of concern into impaired waterbodies, implementation of provisions of approved TMDLs, and description of methods to evaluate whether storm water controls are adequate to meet the requirements of approved TMDLs.

In order to evaluate SWMP effectiveness and demonstrate compliance with specified WLAs, MS4s must develop and implement appropriate monitoring programs. An effective monitoring program could include:

- Effluent monitoring at selected outfalls that are representative of particular land uses or geographical areas that contribute to pollutant loading before and after implementation of pollutant control measures.

- Analytical monitoring of pollutants of concern in receiving waterbodies, both upstream and downstream of MS4 discharges, over an extended period of time.

- Instream biological monitoring at appropriate locations to demonstrate recovery of biological communities after implementation of storm water control measures.

The appropriate Environmental Field Office (ref.: http://tennessee.gov/environment/eac/index.php) should be consulted for assistance in the determination of monitoring strategies, locations, frequency, and methods within 12 months after the approval date of this TMDL. Details of the monitoring plan and monitoring data should be included in the annual report required by the MS4 permit.

8.2 Nonpoint Sources

The Tennessee Department of Environment & Conservation (TDEC) has no direct regulatory authority over most nonpoint source discharges. Reductions of sediment loading from nonpoint sources (NPS) will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. There are links to a number of publications and information resources on USEPA's Nonpoint Source Pollution website (http://www.epa.gov/owow/nps/pubs.html) relating to the implementation and evaluation of nonpoint source pollution control measures.

TMDL implementation activities will be accomplished within the framework of Tennessee's Watershed Approach (ref.: http://www.state.tn.us/environment/wpc/watershed/). The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring, assessment, TMDLs, WLAs/LAs, and permit issuance. It relies on participation at the federal, state, local, and nongovernmental levels to be successful.

The actions of local government agencies and watershed stakeholders should be directed to accomplish the goal of a reduction of sediment loading in the watershed. There are a number of measures that are particularly well-suited to action by local stakeholder groups. These measures include, but are not limited to:

- Detailed surveys of impaired subwatersheds to identify additional sources of sediment loading.
- Advocacy of local area ordinances and zoning that will minimize sediment loading to waterbodies, including establishment of buffer strips along streambanks, reduction of activities within riparian areas, and minimization of road and bridge construction impacts.
- Educating the public as to the detrimental effects of sediment loading to waterbodies and measures to minimize this loading.
- Advocacy of agricultural BMPs (e.g., riparian buffer, animal waste management systems, waste utilization, stream stabilization, fencing, heavy use area treatment protection, livestock exclusion, etc.) and practices to minimize erosion and sediment transport to streams. The Tennessee Department of Agriculture (TDA) keeps a database of BMPs implemented in Tennessee. Of the 125 BMPs in the South Fork Holston River Watershed as of March 28, 2006, 88 are in sediment-impaired subwatersheds (ref.: Figure 8).

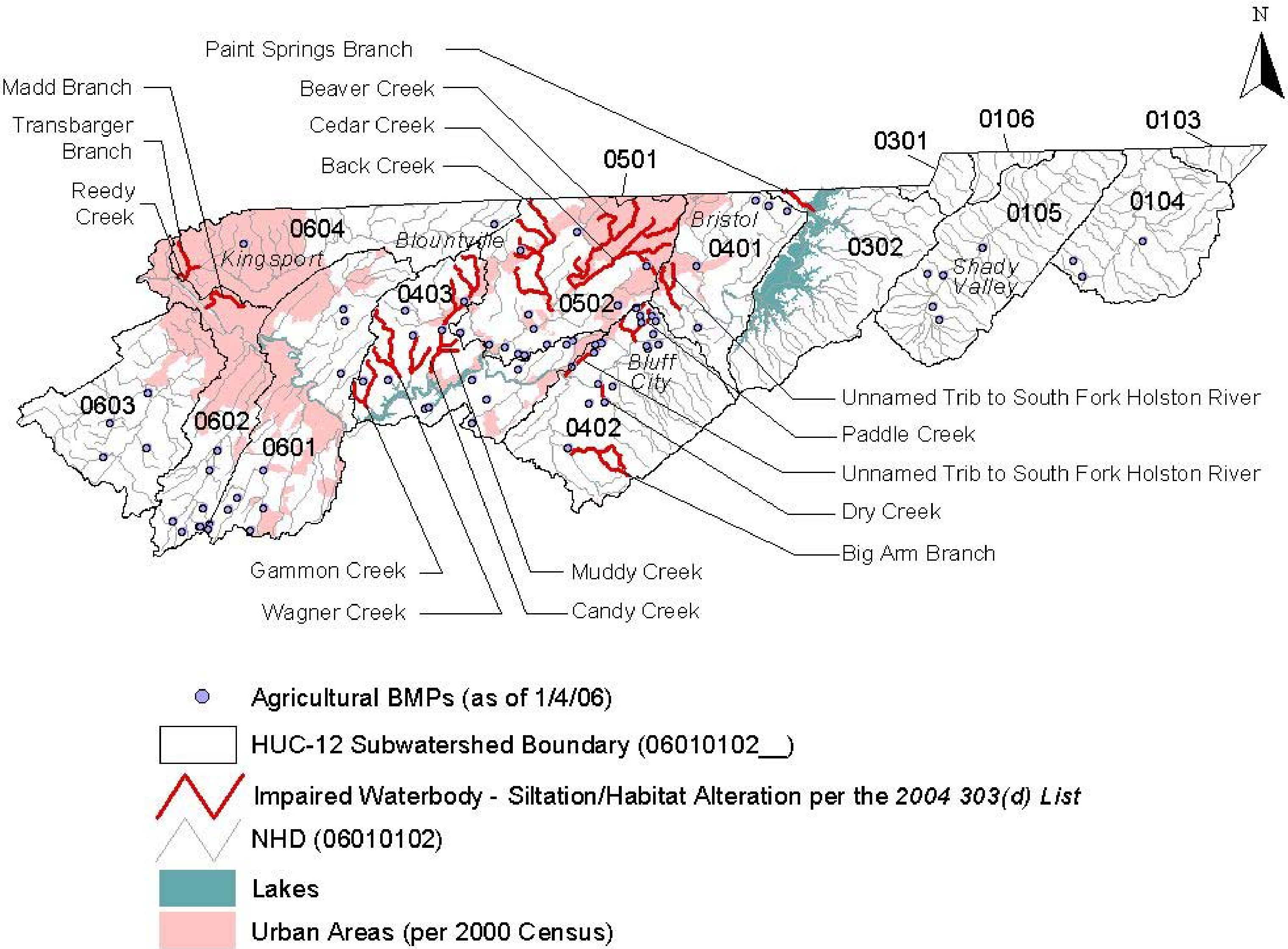
Excellent examples of stakeholder involvement and action include the Kingsport Citizens for a Cleaner Environment, Friends of Fort Patrick Henry, The Holston River Watershed Alliance, The Boone Watershed Partnership, and The Beaver Creek Watershed Alliance. A brief discussion of each group and their mission and activities follows:

Kingsport Citizens for a Cleaner Environment (KCCE) is a new organization situated in the South Fork Holston River Watershed. Chartered in late 2001, they are committed to improving, protecting and preserving the region and are concerned about the quality of our air, land and water. In the past year they have partnered with the Holston Watershed Alliance (HWA) and the Tennessee Valley Authority's Resource Stewardship project to make the South Fork and mainstem Holston River Watersheds one of the best in Tennessee.

Regarding Madd Branch, KCCE joined with the Dobyns-Bennett High School Geography class each spring from (2002 to 2004) to clean out the hundreds of bags of garbage found in less than a mile of that stream. During recent clean-ups, they noticed that ducks, including newly hatched ducklings, have been coming back to the stream. Students also witnessed turtles and other signs of improved conditions that support aquatic life in the creek. At the Clean Air Conference and Youth Forum in 2002, students planted trees along the banks. Another concern is persuading homeowners along the creek to use less chemicals on their yards (which wash into the creek), causing choking growths of algae in the summer months.

In the fall of 2003, KCCE worked with Kingsport's Girls, Inc., Dobyns-Bennett High School's Stone Soup group, and Sullivan County's Middle School 4-Hers to monitor more than 20 streams, most in the South Fork of the Holston Watershed. This project was carried out as part of the World Water Monitoring Day activities throughout the world. Students found a wide variety of stream qualities in their testings, which included pH, turbidity, dissolved oxygen, water temperatures, etc. Results are listed along with other Tennessee water quality results at http://www.worldwatermonitoringday.org. For more information, contact Rachael Bliss, Program Director, (423)-247-2481, kingcitizens@cs.com.

Figure 8 Location of Agricultural Best Management Practices in the South Fork Holston River Watershed



Friends of Fort Patrick Henry is a tax-exempt organization dedicated to improving water quality in Fort Patrick Henry Reservoir. The group is made up of property owners, citizens, and local agencies. Cleanups to remove man-made trash are held twice a year in cooperation with TVA, local governments, and public agencies. Water quality testing is conducted and an ongoing Lake Watch effort is ongoing. For further information, contact Harry Miles at 423-239-8242, hmiles@chartertn.net.

The Holston River Watershed Alliance was formed in March 2000 by TVA to define a vision for the Holston River Watershed and to involve key stakeholders in a sustainable collation advancing that vision. Kingsport Tomorrow, TVA, business and government leaders from Kingsport, Sullivan and Hawkins Counties and the State of Tennessee are active partners in the effort. For information on how to become involved in this partnership effort, contact Sam Jones (Chairman) at 423-239-8225 or Susan LaGuardia at slaguardia@kingsporttomorrow.org.

The Boone Watershed Partnership was formed in 1995 by TVA-CWI to begin pulling together resource management agencies, local governments and interest groups and to work toward a community based program of identifying and correcting water quality problems. Their mission is to partner with local users, regional, state and federal entities, educators and others to identify and address water resource issues in the Boone Watershed. Their objectives are to share information on water conditions and issues among resource agencies, water users and the public; develop consensus on priorities and actions needed to address regional issues; marshal resources to carry out needed actions; and promote awareness of the importance of water resources to the regional economy and to the quality of life. The BWP has received numerous awards, including the Educator Award, the Municipality Award, and the Organization Award in 1998 and TDEC's 1998 Aquatic Resource Preservation Award.

The BWP is dedicated to improving water resources in the Boone Watershed and can be contacted by emailing Gary Barrigar at barrigargn@earthlink.net. More information can be found at www.geocities.com/boonewatershed/.

The Beaver Creek Watershed Alliance is actively coordinating with the Keep Bristol Beautiful. For more information, contact Genette Patton at GPatton@bristolchamber.org.

8.3 Evaluation of TMDL Effectiveness

The effectiveness of the TMDL will be assessed within the context of the State's rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be reevaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDLs for the South Fork Holston River Watershed was placed on Public Notice for a 35-day period and comments were solicited. Steps that were taken in this regard included:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The notice invited public and stakeholder comments and provided a link to a downloadable version of the TMDL document.

2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings, which was sent to approximately 90 interested persons or groups who had requested this information.

3) A letter was sent to following point source facilities in the South Fork Holston River Watershed that are permitted to discharge treated total suspended solids (TSS) and are located in impaired subwatersheds advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also stated that a written copy of the draft TMDL document would be provided on request. Letters were sent to the following facilities:

TNG110297	Transit-Mix Concrete Company
TNG110123	Tri-Cities Concrete Co., Inc.
TNG110140	Byerley Const. Co. Inc.
TNG110249	Ross Prestressed Concrete Co., Inc.
TN0064157	Vulcan Construction Materials, LP
TN0054445	General Shale Products, LLC

4) A letter was sent to identified water quality partners in the South Fork Holston River Watershed advising them of the proposed sediment TMDLs and their availability on the TDEC website and inviting comments. These partners included:

Natural Resources Conservation Service
United States Geological Survey
United States Fish and Wildlife Service
Tennessee Valley Authority
Tennessee Department of Agriculture
Virginia Department of Environmental Quality
Kingsport Citizens for a Cleaner Environment
Friends of Fort Patrick Henry
Holston River Watershed Alliance

5) A draft copy of the proposed sediment TMDLs was sent to the following MS4s:

TNS075124	Carter County
TNS075183	Bristol
TNS075370	Johnson City
TNS075388	Kingsport
TNS075574	Hawkins County
TNS075671	Sullivan County
TNS075787	Washington County
TNS077585	Tennessee Department of Transportation (TDOT)
TNS077780	Bluff City

Two comments were received in the public notice period. A copy of the comments is included in Appendix F and the responses to those comments are included in Appendix G.

10.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding these TMDLs should be directed to the following members of the Division of Water Pollution Control staff:

Mary L. Wyatt, Watershed Management Section
E-mail: Mary.Wyatt@state.tn.us

Sherry H. Wang, Ph.D., Watershed Management Section
E-mail: Sherry.Wang@state.tn.us

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APPENDIX A

Example Stream Assessment (Candy Creek at RM 1.7)

Figure A-1 Candy Creek at RM 1.7, p.1 of stream survey – June 4, 2003

STREAM SURVEY FORM

ESTABLISHED STATION — FILL IN SHADED BLANKS OF HEADER | NEW STATION — FILL IN ALL HEADER BLANKS FOR A NEW STATION

STREAM SURVEY INFORMATION STORET#

STREAM: Candy Creek
STREAM LOCATION: SM 1.7 (Chem Stn)
COUNTY CODE:(FIPS) 82 (STATE CODE)
MAJOR BASIN
WBID#/HUC:
WBID NAME:
LAT/LONG DEG:
LAT/LONG DEC: 36-29.392
USGS QUAD: 82-22.877 198NW
Drains to: rm rm
ECOLOGICAL SUBREGION: 67F

ASSESSORS: TAR/RGC
DATE: 6/4/03
TIME: 1510
STREAM MILE: 1.8
STREAM ORDER:
REACH FILE #
3Q20:
ELEVATION (ft): 1409
FIELD#

OBJECTIVES:

SAMPLES COLLECTED METERS USED:

CHEMICALS Y or N Life Assessed? Macroinvertebrates Fish Algae Other:
Additional List Attached? Yes / No Samples returned ? Y or N Sampling Method: SQKICK
TF

FIELD ANALYSIS:

pH	SU	DISSOLVED OXYGEN	PPM
CONDUCTIVITY	UMHOS	TIME	
TEMPERATURE	C	OTHERS	

Previous 48 hours Precip: UNKNOWN NONE LITTLE MODERATE HEAVY FLOODING
Ambient Weather: SUNNY CLOUDY BREEZY RAIN SNOW

WATERSHED CHARACTERISTICS App. % of watershed observed: 100

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	100	URBAN		RESID	
CROPS		INDUSTRY		OTHER	
FOREST		MINING			

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES			SOURCES		
Pesticides (0200)		Flow Alter. (1500) M			Unknown (9000)
Metals (0500)		Habitat Alt. (1600) H	Point Source: Indust (0100)		Municipal (2000)
Ammonia (0600)		Thermal Alt. (1400) H	Logging (2000)		Mining (5000)
Chlorine (0700)		Pathogens (1700) H	Construction;Land Devel (3200)		Road /bridge (3100) M
Nutrients (0900) H		Oil & grease (1900)	U/S Dam (8800)		Urban Runoff (4000)
pH (1000)		Unknown (0000)	Riparian loss (7600)		Bank destabilization (7700) H
Organic Enrichment / Low D.O. H (1200)		Siltation (1100) H	Agriculture: Row crop (1000)		Intensive Feedlot (1600)
Other:			Livestock grazing-riparian (1410) H		Dredging (7200)
			Other:		

PHYSICAL STREAM CHARACTERISTICS LENGTH OF STREAM AREA ASSESSED (m):

SURROUNDING LAND USE (facing downstream) :

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	98	100	URBAN			RESID.	2	
CROPS			INDUSTRY			OTHER		
FOREST			MINING					

% CANOPY COVER: 0% Open(0-10) Partly Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)
BANK HEIGHT (m): 1-1.5 HIGH WATER MARK (m): 1-2
SEDIMENT DEPOSITS: NONE SLIGHT MODERATE EXCESSIVE BLANKET
TYPE: SLUDGE MUD SAND SILT NONE OTHER Contaminated Y or N
TURBIDITY CLEAR SLIGHT MODERATE HIGH OPAQUE
EXCESSIVE ALGAE PRESENT? NONE SLIGHT MODERATE CHOKING
AQUATIC VEGET. ROOTED FLOATING TYPE Watercress
ADDITIONAL COMMENTS:(oil sheen, odor, colors)

Page 1

revised 8-10-98

Figure A-2 Candy Creek at RM 1.7, p.2 of stream survey – June 4, 2003

STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	.01-.02	Contains	
WIDTH (m)	.3-.4	.5-.7	
REACH LENGTH (m)	2-2.5		

Staff Gauge/Bench Ht: ______
VELOCITY (CFS) ______
FLOW (CFS) ______
HABITAT ASSESSMENT SCORE #: 95
RR # ______ GP # ______

Gradient (sample reach): Flat Low Mode. High Cascade

Size (stream width) : V. Small (<1.5m) Small (1.5-3m) Med (3-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (%) Particle Count - 100 points (mm). Circle one: RIFFLE RUN

Record measured particle size. Use abbrev. below for smaller sizes.*

size (mm)	description	abbreviation							
<0.062	silt/clay	cl	1-10						
0.062-0.125	very fine sand	vfs	11-20						
0.125-.250	fine sand	fs	21-30						
0.25-0.50	med sand	ms	31-40		Silt				
0.5-1.0	coarse sand	cs	41-50						
1.0-2.0	very coarse sand	(use actual size)	51-60						
2.0-64.0	gravel	(use actual size)	61-70						
64-256	cobble	(use actual size)	71-80						
256-4096	boulder	(use actual size)	81-90						
---	bedrock	bdrx	91-100						
---	woody debris	wood							

BIOLOGICAL ASSESSMENT

LIST LOG NUMBERS OF SAMPLES: ______

RELATIVE ABUNDANCE OF TAXA

HABITAT

DOMINANT (>=50): ______
VERY ABUND.(30-49): ______
ABUNDANT (10-29): ______
COMMON (3-9): ______
RARE (<3): ______

STREAM USE SUPPORT:

SPECIFICALLY CLASSIFIED FOR: (circle)

Dom. H2O Supply Ind. H2O Supply Navigation TIER II/TIER III Trout >> Nat. Repr?

WATER WITHDRAWL NOTED ______

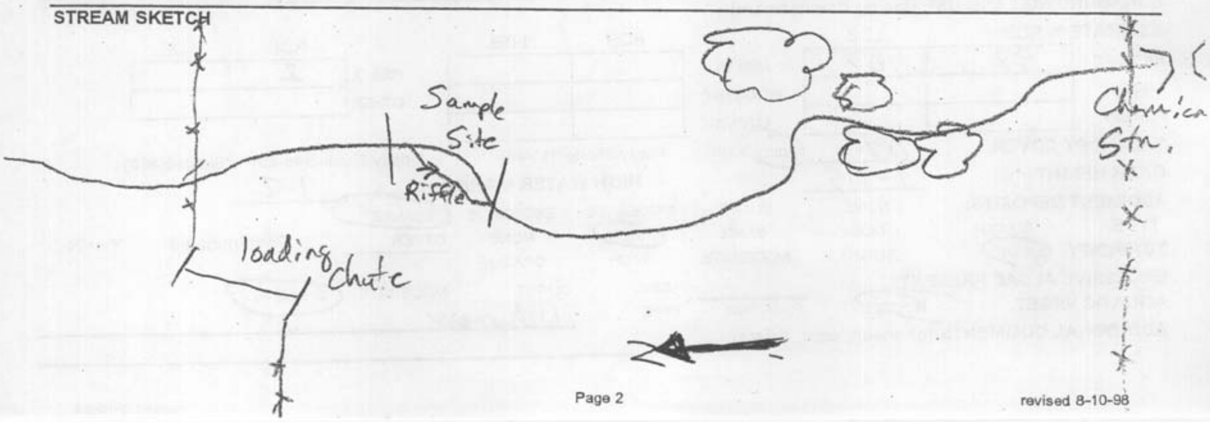
IS STREAM POSTED? (circle) Fish Tissue Advis.: Do Not Consume Precautionary
Bacteriological Advis.

BASED ON OBSERVATIONS AND DATA, STREAM IS:(circle)

FULLY SUPPORTING (FS) SUPPORTING, BUT THREATENED (TH) PARTIALLY SUPPORTING (PS) NONSUPPORTING (NS)

COMMENTS: photos ? Y or N Roll # Photo # 5

STREAM SKETCH



revised 8-10-98

Figure A-3 Candy Creek at RM 1.7, front of field sheet – June 4, 2003

DRAFT REVISION—July 28, 1997 H0306002

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

95

STREAM NAME Candy Creek	LOCATION 300m U/S Chem. Site
STATION # ___ RIVERMILE 1.8	STREAM CLASS
LAT ___ LONG ___	RIVER BASIN
STORET # CANDY001.7SU	AGENCY WPC
INVESTIGATORS TAR/RGC	
FORM COMPLETED BY TAR	DATE 6/4/03 TIME 1510 AM PM — REASON FOR SURVEY Watershed

Parameters to be evaluated in sampling reach

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness 74	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime 59	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition 4	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status 35	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Figure A-4 Candy Creek at RM 1.7, back of field sheet – June 4, 2003

DRAFT REVISION—July 28, 1997

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Pasture was empty during survey. When in use, very little veg. prot.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 95

Figure A-5 Photos of Candy Creek at RM 1.7, Upstream views of Candy Creek off Hawley Rd (CANDY001.7SU) – June 4, 2003

Figure A-6 Photos of Candy Creek at RM 1.7, Looking downstream from macroinvertebrate collection site at loading chute area. – June 4, 2003

Figure A-7 Photos of Candy Creek at RM 1.7, Views of downstream chemical/ bacteriological sampling site, looking upstream – June 4, 2003

APPENDIX B

Watershed Sediment Loading Model

WATERSHED SEDIMENT LOADING MODEL

Determination of target average annual sediment loading values for reference watersheds and the sediment loading analysis of waterbodies impaired for siltation/habitat alteration was accomplished utilizing the Watershed Characterization System (WCS) Sediment Tool (v.3). WCS (v.2_1) is an ArcView geographic information system (GIS) based program developed by USEPA Region IV to facilitate watershed characterization and TMDL development. WCS consists of an initial set of spatial and tabular watershed data, stored in a database, and allows the incorporation of additional data when available. It provides a number of reporting tools and data management utilities to allow users to analyze and summarize data. Program extensions, such as the sediment tool, expand the functionality of WCS to include modeling and other more rigorous forms of data analysis (USEPA, 2001).

Sediment Analysis

The Sediment Tool is an extension of WCS that utilizes available GIS coverages (land use, soils, elevations, roads, etc), the Universal Soil Loss Equation (USLE) to calculate potential erosion, and sediment delivery equations to calculate sediment delivery to the stream network. The following tasks can be performed:

- Estimate extent and distribution of potential soil erosion in the watershed.
- Estimate potential sediment delivery to receiving waterbodies.
- Evaluate effects of land use, BMPs, and road network on erosion and sediment delivery.

The Sediment Tool can also be used to evaluate different scenarios, such as the effects of changing land uses and implementation of BMPs, by the adjustment of certain input parameters. Parameters that may be adjusted include:

- Conservation management and erosion control practices
- Changes in land use
- Implementation of Best Management Practices (BMPs)
- Addition/Deletion of roads

Sediment analyses can be performed for single or multiple watersheds.

Universal Soil Loss Equation

Erosion potential is based on the Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith. It has been the most widely accepted and utilized soil loss equation for over 30 years. The USLE is a method to predict the average annual soil loss on a field slope based on rainfall pattern, soil type, topography, crop system and management practices. The USLE only predicts the amount of soil loss resulting from sheet or rill erosion on a single slope and does not account for soil losses that might occur from gully, wind, or tillage erosion. Designed as a model for use with certain cropping and management systems, it is also applicable to non-agricultural situations (OMAFRA, 2000). While the USLE can be used to estimate long-term average annual soil loss, it cannot be applied to a specific year or a specific storm. Based on its long history of use and wide acceptance by the forestry and agricultural communities, the USLE was considered to be an adequate tool for estimating the relative long-term average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures.

Soil loss from sheet and rill erosion is primarily due to detachment of soil particles during rain events. It is the cause of the majority of soil loss for lands associated with crop production, grazing areas, construction sites, mine sites, logging areas and unpaved roads. In the USLE, five major factors are used to calculate the soil loss for a given area. Each factor is the numerical estimate of a specific condition that affects the severity of soil erosion in that area. The USLE for estimating average annual soil erosion is expressed as:

$$A = R \times K \times LS \times C \times P$$

where:

A = average annual soil loss in tons per acre
R = rainfall erosivity index
K = soil erodibility factor
LS = topographic factor - L is for slope length and S is for slope
C = crop/vegetation and management factor
P = conservation practice factor

Evaluating the factors in USLE:

<u>R - Rainfall Erosivity Index</u>

The rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. This index varies with geography.

<u>K - Soil Erodibility Factor</u>

This factor quantifies the cohesive or bonding character of the soil and its ability to resist detachment and transport during a rainfall event. The soil erodibility factor is a function of soil type.

<u>LS - Topographic Factor</u>

The topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. For convenience L and S are frequently lumped into a single term.

<u>C - Crop/Vegetation and Management Factor</u>

The crop/vegetation and management factor represents the effect that ground cover conditions, soil conditions and general management practices have on soil erosion. It is the most computationally complicated of USLE factors and incorporates the effects of: tillage management, crop type, cropping history (rotation), and crop yield.

P - Conservation Practice Factor

The conservation practice factor represents the effects on erosion of Best Management Practices (BMPs) such as contour farming, strip cropping and terracing.

Estimates of the USLE parameters, and thus the soil erosion as computed from the USLE, are provided by the Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition, and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country.

The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil lost in the field that is eventually delivered to the stream depends on several factors. These include, the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas will be delivered into the stream with runoff-producing rainfall.

Sediment Modeling Methodology

Using WCS and the Sediment Tool, average annual sediment loading to surface waters was modeled according to the following procedures:

1. A WCS project was setup for the watershed that is the subject of these TMDLs. Additional data layers required for sediment analysis were generated or imported into the project. These included:

    DEM (grid) - The Digital Elevation Model (DEM) layers that come with the basic WCS distribution system are shapefiles of coarse resolution (300x300m). A higher resolution DEM grid layer (30x30m) is required. The National Elevation Dataset (NED) is available from the USGS website and the coverage for the watershed (8-digit HUC) was imported into the project.

    Road - A road layer is needed as a shape file and requires additional attributes such as road type, road practice, and presence of side ditches. If these attributes are not provided, the Sediment Tool automatically assigns default values: road type - secondary paved roads, side ditches present and no road practices. This data layer was obtained from ESRI for areas in the watershed.

    Soil - The SSURGO (1:24k) soil data may be imported into the WCS project if higher-resolution soil data is required for the estimation of potential erosion. If the SSURGO soil database is not available, the system uses the STATSGO Soil data (1:250k) by default.

    MRLC Land Use - The Multi-Resolution Land Characteristic (MRLC) data set for the watershed is provided with the WCS package, but must be imported into the project.

2. Using WCS, the entire watershed was delineated into subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). These delineations are shown in Figure 4. All of the sediment analyses were performed on the basis of these drainage areas. Land use distribution for impaired subwatersheds is summarized in Appendix C.

The following steps are accomplished using the WCS Sediment Tool:

3. For a selected watershed or subwatershed, a sediment project is set up in a new view that contains the data layers that will be subsequently used to calculate erosion and sediment delivery.

4. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on National Hydrology Dataset (NHD), to the DEM grid.

5. For each 30 by 30 meter grid cell within the subwatershed, the Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

   - Distance-based equation (Sun and McNulty, 1998)
     $Mad = M * (1-0.97 * D/L)$
     where: Mad = mass moved (tons/acre/yr)
     M = sediment mass eroded (ton)
     D = least cost distance from a cell to the nearest stream grid (ft)
     L = maximum distance the sediment may travel (ft)

   - Distance Slope-based equation (Yagow et al., 1998)
     $DR = \exp(-0.4233 * L * So)$
     $So = \exp(-16.1 * r/L + 0.057)) - 0.6$
     where: DR = sediment delivery ration
     L = distance to the stream (m)
     r = relief to the stream (m)

   - Area-based equation (USDASCS, 1983)
     $DR = 0.417762 * A^{(-0.134958)} - 1.27097, \quad DR <= 1.0$
     where: DR = sediment delivery ratio
     A = area (sq miles)

   - WEEP-based regression equation (Swift, 2000)
     $Z = 0.9004 - 0.1341 * X^2 + X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$
     where: Z = percent of source sediment passing to the next grid cell
     X = cumulative distance down slope (X > 0)
     Y = percent slope in the grid cell (Y > 0)

   The distance slope based equation (Yagow et al., 1998) was selected to simulate sediment delivery in the South Fork Holston River Watershed.

6. The total sediment delivered upstream of each subwatershed "pour point" is calculated. The sediment analysis provides the calculations for six new parameters:

   - Source Erosion - estimated erosion from each grid cell due to the land cover
   - Road Erosion - estimated erosion from each grid cell representing a road
   - Composite Erosion - composite of the source and road erosion layers

- Source Sediment - estimated fraction of the soil erosion from each grid cell that reaches the stream (sediment delivery)
- Road Sediment - estimated fraction of the road erosion from each grid cell that reaches the stream
- Composite Sediment - composite of the source and erosion sediment layers

The sediment delivery can be calculated based on the composite sediment, road sediment or source sediment layer. The sources of sediment by each land use type is determined showing the types of land use, the acres of each type of land use and the tons of sediment estimated to be generated from each land use.

7. For each subwatershed of interest, the resultant sediment load calculation is expressed as a long-term average annual soil loss expressed in pounds per year calculated for the rainfall erosivity index (R). This statistic is calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30-minute intensity.

   Calculated erosion, sediment loads delivered to surface waters and unit loads (per unit area) for subwatersheds that contain waters on the *2004 303(d) List* as impaired for siltation and/or habitat alteration are summarized in Tables B-1, B-2, and B-3, respectively.

Table B-1 Calculated Erosion - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010102__)	***EROSION***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0302	60,634	16,192	76,826	78.9	21.1
0401	7,821	3,041	10,862	72.0	28.0
0402	8,793	5,769	14,562	60.4	39.6
0403	9,107	6,273	15,380	59.2	40.8
0502	17,066	5,722	22,788	74.9	25.1
0602	11,490	4,415	15,905	72.2	27.8
0604	17,635	5,001	22,636	77.9	22.1

Table B-2 Calculated Sediment Delivery to Surface Waters - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010102__)	*SEDIMENT*				
	Road [tons/yr]	Source [tons/yr]	Total [tons/yr]	%Road	%Source
0302	30,278	5,811	36,089	83.9	16.1
0401	4,823	1,170	5,993	80.5	19.5
0402	5,161	2,407	7,568	68.2	31.8
0403	4,363	2,017	6,380	68.4	31.6
0502	9,592	2,218	11,810	81.2	18.8
0602	6,364	1,839	8,203	77.6	22.4
0604	8,572	1,992	10,563	81.1	18.9

Table B-3 Unit Loads - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010102__)	HUC-12 Subwatershed Area	*UNIT LOADS*			
		Erosion		Sediment	
	[acres]	[tons/ac/yr]	[lbs/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
0101	13,337	0.530	1,059	0.248	496
0302	34,232	2.244	4,489	1.054	2,108
0401	23,175	0.469	937	0.259	517
0402	35,891	0.406	811	0.211	422
0403	32,562	0.472	945	0.196	392
0502	36,386	0.626	1,253	0.325	649
0602	23,752	0.670	1,339	0.345	691
0604	29,819	0.759	1,518	0.354	708

APPENDIX C

MRLC Land Use of Impaired Subwatersheds and Ecoregion Reference Site Drainage Areas

Table C-1 South Fork Holston River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010102___)							
	0302		0401		0402		0403	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	204	0.6	15	0.1	25	0.1	135	0.4
Deciduous Forest	23,482	68.6	10,364	44.7	20,723	57.7	8,458	26
Developed Open Space	747	2.2	2,064	8.9	1,564	4.4	2,652	8.1
Evergreen Forest	1,665	4.9	829	3.6	1,039	2.9	203	0.6
Grassland/Herbaceous	306	0.9	263	1.1	680	1.9	576	1.8
High Intensity Development	0	0.0	1	0.0	69	0.2	128	0.4
Low Intensity Development	46	0.1	432	1.9	387	1.1	1,181	3.6
Medium Intensity Development	2	0.0	26	0.1	83	0.2	423	1.3
Mixed Forest	1,297	3.8	652	2.8	1,047	2.9	163	0.5
Open Water	5,191	15.2	149	0.6	65	0.2	1,614	5.0
Pasture/Hay	933	2.7	7,958	34.3	9,354	26.1	16,448	50.5
Row Crops	82	0.2	255	1.1	474	1.3	414	1.3
Shrub/Scrub	275	0.8	126	0.5	357	1.0	146	0.4
Woody Wetlands	2	0.0	41	0.2	22	0.1	20	0.1
Total	**34,232**	**100.0**	**23,175**	**100.0**	**35,891**	**100.0**	**32,562**	**100.0**

Table C-1 (Cont.) South Fork Holston River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010102___)					
	0502		0602		0604	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	40	0.1	26	0.1	26	0.1
Deciduous Forest	14,415	39.6	5,342	22.5	10,021	33.6
Developed Open Space	5,088	14.0	3,208	13.5	4,923	16.5
Evergreen Forest	271	0.7	83	0.3	129	0.4
Grassland/Herbaceous	338	0.9	308	1.3	493	1.7
High Intensity Development	333	0.9	809	3.4	628	2.1
Low Intensity Development	3,398	9.3	3,276	13.8	4,010	13.4
Medium Intensity Development	1,147	3.2	920	3.9	1,126	3.8
Mixed Forest	256	0.7	74	0.3	126	0.4
Open Water	74	0.2	210	0.9	2	0.0
Pasture/Hay	10,473	28.8	9,115	38.4	8,015	26.9
Row Crops	415	1.1	294	1.2	184	0.6
Shrub/Scrub	85	0.2	46	0.2	61	0.2
Woody Wetlands	52	0.1	41	0.2	73	0.2
Total	**36,386**	**100.0**	**23,752**	**100.0**	**29,819**	**100.0**

Table C-2 Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66d01		Eco66d03		Eco66d05		Eco66d06		Eco66d07	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	1	0.1	40	0.4	0	0.0	0	0.0	0	0.0
Deciduous Forest	749	98.6	9,589	85.9	593	100.0	632	97.9	1,513	98.2
Developed Open Space	1	0.1	136	1.2	0	0.0	0	0.1	15	1.0
Evergreen Forest	1	0.1	389	3.5	0	0.0	4	0.7	1	0.1
Grassland/Herbaceous	0	0.0	109	1.0	0	0.0	0	0.0	0	0.0
High Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Medium Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	6	0.8	157	1.4	0	0.0	9	1.3	9	0.6
Open Water	1	0.2	6	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	0	0.0	543	4.9	0	0.0	0	0.0	2	0.1
Row Crops	0	0.0	5	0.0	0	0.0	0	0.0	0	0.0
Shrub/Scrub	1	0.2	187	1.7	0	0.0	0	0.0	1	0.1
Woody Wetlands	0	0.0	1	0.0	0	0.0	0	0.0	0	0.0
Total	**760**	**100.0**	**11,163**	**100.0**	**593**	**100.0**	**645**	**100.0**	**1,541**	**100.0**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66e04		Eco66e09		Eco66e11		Eco66e17		Eco66e18	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	4	0.1	0	0.0	2	0.1	0	0.0
Deciduous Forest	2,583	95.1	5,209	88.4	2,153	98.5	1,355	72.1	1,652	60.4
Developed Open Space	3	0.1	0	0.0	2	0.1	5	0.2	11	0.4
Evergreen Forest	27	1.0	241	4.1	14	0.7	166	8.8	604	22.1
Grassland/Herbaceous	2	0.1	10	0.2	0	0.0	14	0.7	0	0.0
High Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Medium Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	30	1.1	218	3.7	11	0.5	292	15.5	461	16.9
Open Water	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	61	2.2	0	0.0	2	0.1	1	0.0	2	0.1
Row Crops	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Shrub/Scrub	9	0.3	207	3.5	2	0.1	46	2.5	3	0.1
Woody Wetlands	0	0.0	0	0.0	2	0.1	0	0.0	0	0.0
Total	**2,715**	**100.0**	**5,890**	**100.0**	**2,186**	**100.0**	**1,881**	**100.0**	**2,732**	**100.0**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66f06		Eco66f07		Eco67f06		Eco67f13		Eco67f16	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	11	0.0	0	0.0	1	0.1	185	0.7
Deciduous Forest	8,604	62.1	23,151	79.1	1,628	82.4	1,486	86.2	14,168	52.5
Developed Open Space	260	1.9	851	2.9	117	5.9	74	4.3	1,135	4.2
Evergreen Forest	2,663	19.2	614	2.1	14	0.7	2	0.1	172	0.6
Grassland/Herbaceous	3	0.0	71	0.2	24	1.2	27	1.6	5,989	22.2
High Intensity Development	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Development	2	0.0	16	0.1	4	0.2	1	0.1	262	1.0
Medium Intensity Development	0	0.0	4	0.0	0	0.0	0	0.0	76	0.3
Mixed Forest	557	4.0	669	2.3	102	5.2	80	4.6	1,184	4.4
Open Water	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	1,528	11.0	3,395	11.6	19	0.9	7	0.4	3,773	14.0
Row Crops	152	1.1	166	0.6	0	0.0	0	0.0	13	0.0
Shrub/Scrub	13	0.1	175	0.6	36	1.8	32	1.9	16	0.1
Woody Wetlands	76	0.6	133	0.5	33	1.7	13	0.8	0	0.0
Total	**13,859**	**100.0**	**29,258**	**100.0**	**1,976**	**100.0**	**1,725**	**100.0**	**26,976**	**100.0**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed											
	Eco67f17		Eco67f23		Eco67g05		Eco67g10		Eco67g11		Eco67i12	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	169	0.6	53	0.3	12	0.1	1	0.0	0	0.0	0	0.0
Deciduous Forest	16,663	55.4	6,841	45.1	4,929	23.4	6,387	48.2	969	95.1	562	82.5
Developed Open Space	1,385	4.6	636	4.2	1,337	6.3	629	4.8	7	0.7	55	8.1
Evergreen Forest	704	2.3	110	0.7	1,023	4.9	621	4.7	25	2.4	13	2.0
Grassland/Herbaceous	5,318	17.7	3,984	26.3	367	1.7	155	1.2	0	0.0	0	0.0
High Intensity Development	5	0.0	0	0.0	7	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Development	558	1.9	232	1.5	157	0.7	71	0.5	0	0.0	7	1.0
Medium Intensity Development	59	0.2	50	0.3	44	0.2	3	0.0	0	0.0	0	0.0
Mixed Forest	1,918	6.4	512	3.4	833	4.0	516	3.9	18	1.8	9	1.3
Open Water	2	0.0	0	0.0	4	0.0	0	0.0	0	0.0	1	0.2
Pasture/Hay	3,223	10.7	2,704	17.8	11,733	55.7	4,638	35.0	0	0.0	13	2.0
Row Crops	1	0.0	1	0.0	298	1.4	37	0.3	0	0.0	0	0.0
Shrub/Scrub	52	0.2	28	0.2	236	1.1	166	1.3	0	0.0	0	0.0
Woody Wetlands	5	0.0	9	0.1	84	0.4	13	0.1	0	0.0	20	3.0
Total	**30,063**	**100.0**	**15,160**	**100.0**	**21,064**	**100.0**	**13,237**	**100.0**	**1,019**	**100.0**	**681**	**100.0**

APPENDIX D

Estimate of Existing Point Source Loads for NPDES Permitted Ready Mixed Concrete Facilities and Mining Sites

Determination of Existing Point Source Sediment Loads

Existing point source sediment loads for RMCFs and mining sites located in impaired HUC-12 subwatersheds were estimated using the methodologies described below.

Ready Mixed Concrete Facilities (RMCFs)

Total loading from RMCFs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (ref.: Table D-1) from RMCFs located in an impaired subwatershed were determined as follows.

The existing loading from process wastewater discharge for RMCFs is based on facility design flow, the monthly average permit limit for TSS, and the area of the HUC-12 subwatershed in which the facilities are located. Loads are expressed as average annual loads per unit area and are summarized in Table D-1.

$$AAL_{RMCF} = \frac{(Q_d) \text{ x } (MAvg)\ (8.34 \text{ lb-l/gal-mg})\ (365 \text{ days/yr})}{(A_{HUC\text{-}12})}$$

where: AAL_{RMCF} = Average annual load [lb/ac/yr]
Q_d = Facility design flow [MGD]
MAvg = Monthly average concentration limit for TSS [mg/l]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

The existing loading from storm water runoff for RMCFs is based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which each facility is located (ref.: Table D-1). Site runoff was estimated by assuming that one-half of the annual precipitation falling on the site drainage area results in runoff. Annual precipitation for the South Fork Holston River Watershed is approximately 48 in/yr (Midwest Plan Service, 1985).

$$AAL_{RMCF} = \frac{(A_d)\ (DMax)\ (Precip)\ (0.2266 \text{ lb-l/ac-in-mg})\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL_{RMCF} = Average annual load [lb/ac/yr]
A_d = Facility (site) drainage area [acres]
DMax = Daily maximum concentration limit for TSS [mg/l]
Precip = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table D-1 Estimate of Existing Loads - Ready Mixed Concrete Facilities

HUC-12 Subwatershed (06010102__)	Subwatershed Area	NPDES Permit No.	Process Wastewater			Storm Water Runoff			Total Annual Average Load
			Estimated Flow	Daily Maximum TSS Limit	Annual Average Load	Site Drainage Area	TSS Cut-off Concentration	Annual Average Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0602	23,752	TNG110297	0.0001	50	0.0006	3.7	200	0.1695	0.170
0604	29,819	TNG110123		50	0.0005	4.1		0.1503	0.151
		TNG110140				1.0		0.0365	0.037
		TNG110249				20.0		0.7295	0.730

Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining site is located (ref.: Table D-2). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the South Fork Holston River Watershed is approximately 48 in/yr (Midwest Plan Service, 1985).

$$AAL_{Mining} = \frac{(A_d)\ (DMax)\ (Precip.)\ (0.2266\ \text{lb-l/ac-in-mg})\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL_{Mining} = Average annual load [lb/ac/yr]
A_d = Facility (site) drainage area [acres]
DMax = Daily maximum concentration limit for TSS [mg/l]
Precip = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table D-2 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06010102___)	Subwatershed Area [acres]	NPDES Permit No.	Site Drainage Area [acres]	Daily Maximum TSS Limit [mg/l]	Annual Average Load [lb/ac/yr]
0502	36,386	TN0064157	166	40	0.992
0602	23,752	TN0054445	30	40	0.275

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

Estimated point source loads were summed for each impaired HUC-12 subwatershed and then compared to both existing and target subwatershed sediment loads (ref.: Table D-3).

Table D-3 Estimate of Existing Point Source Loads in Impaired HUC-12 Subwatersheds

HUC-12 Subwatershed (06010102__)	NPDES Permit No.	Facility Type	Average Annual Point Source Load	Existing Subwatershed Load	Point Source Percentage Of Existing Load	Subwatershed Target Load	Point Source Percentage of Target Load
			[lb/ac/yr]	[lb/ac/yr]	[%]	[lb/ac/yr]	[%]
0502	TN0064157	Mining	**0.992**	649	**0.15**	235.7	**0.42**
0602	TN0054445	Mining	0.275				
	TNG110297	RMCF	0.170				
	Subwatershed 0201 Total		**0.445**	691	**0.06**	358.1	**0.12**
0604	TNG110123	RMCF	0.151				
	TNG110140	RMCF	0.037				
	TNG110249	RMCF	0.730				
	Subwatershed 0202 Total		**0.918**	708	**0.13**	358.1	**0.26**

Note: A spreadsheet was used for this calculation and values are approximate due to rounding.

APPENDIX E

Public Notice Announcement

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR SILTATION & HABITAT ALTERATION IN THE SOUTH FORK HOLSTON RIVER WATERSHED (HUC 06010102), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the South Fork Holston River Watershed located in east Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

A number of waterbodies in the South Fork Holston River Watershed are listed on Tennessee's final 2004 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with land development, urban runoff, and agricultural sources. The TMDLs utilize Tennessee's general water quality criteria, ecoregion reference site data, land use data, digital elevation data, a sediment loading and delivery model, and an appropriate Margin of Safety (MOS) to establish reductions in sediment loading which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 9% to 96% in the listed waterbodies.

The proposed siltation/habitat alteration TMDLs may be downloaded from the Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/proposed.php
(note: this was subsequently changed to http://www.state.tn.us/environment/wpc/tmdl/proposed.shtml)

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Mary Wyatt, Watershed Management Section
Telephone: 615-532-0714
e-mail: Mary.Wyatt@state.tn.us

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656
e-mail: Sherry.Wang@state.tn.us

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than June 12th, 2006 to:

Division of Water Pollution Control
Watershed Management Section
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 6th Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.

APPENDIX F

Public Comments Received

Tennessee Valley Authority, 400 W. Summit Hill Drive, Knoxville, Tennessee 37902

Bridgette K. Ellis
Senior Vice President
Environmental Stewardship and Policy

June 12, 2006

Ms. Sherry H. Wang, Ph. D.
Watershed Management Section
Division of Water Pollution Control
Tennessee Department of Environment and
Conservation (TDEC)
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

To Ms. Wang and All Whom It Concerns:

RE: TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION AND HABITAT ALTERATION IN THE SOUTH HOLSTON RIVER WATERSHED

The Tennessee Valley Authority (TVA), as a manager of natural resources and operator of the multi-purpose Tennessee River system, is vitally concerned with the proper management and stewardship of the River and its watershed. One of the purposes for which we manage the River and carry out watershed activities, is the protection of water quality. Therefore, we have great interest in the condition of waters in the Tennessee Valley and very much appreciate the opportunity to provide written comments on your proposed TMDL.

1. It appears that there is a typographical error in Section 6.1.5. This section mentions the "Upper Duck River."

2. TVA believes that the Boone Watershed Partnership (BWP) and the Beaver Creek Watershed Alliance (Subwatershed group with BWP) should be mentioned in Sections 8.2 and 9.0. Both of these groups have an active interest in the South Fork Holston. Gary Barrigar can be contacted for further information for both groups (423-543-7576 or barrigargn@eathlink.net).

Please call (865-632-6440) or email me (bkellis@tva.gov), or Mark Odom (423-585-2134; mlodom@tva.gov) if you have questions or would like to discuss these comments.

Sincerely,

Bridgette Ellis

Bridgette K. Ellis

APPENDIX G

Response to Public Notice Comments

Response to TVA email dated 6/12/06:

Comment No. 1 regarding a typographical error:

This has been corrected.

Comment No. 2 regarding watershed groups in the South Fork Holston River Watershed:

A representative of Boone Watershed Partnership and the Beaver Creek Watershed Alliance contacted the Division of Water Pollution Control on June 6, 2006 to be added to the contacts list maintained by the Division for stakeholders and interested parties. At that time, they copied TVA's Mark Odom on the notification. Information regarding these stakeholders, as TVA was informed June 13, 2006, will be included in the final draft of the TMDL.